CHEMICAL & METALLURGICAL ENGINEERING

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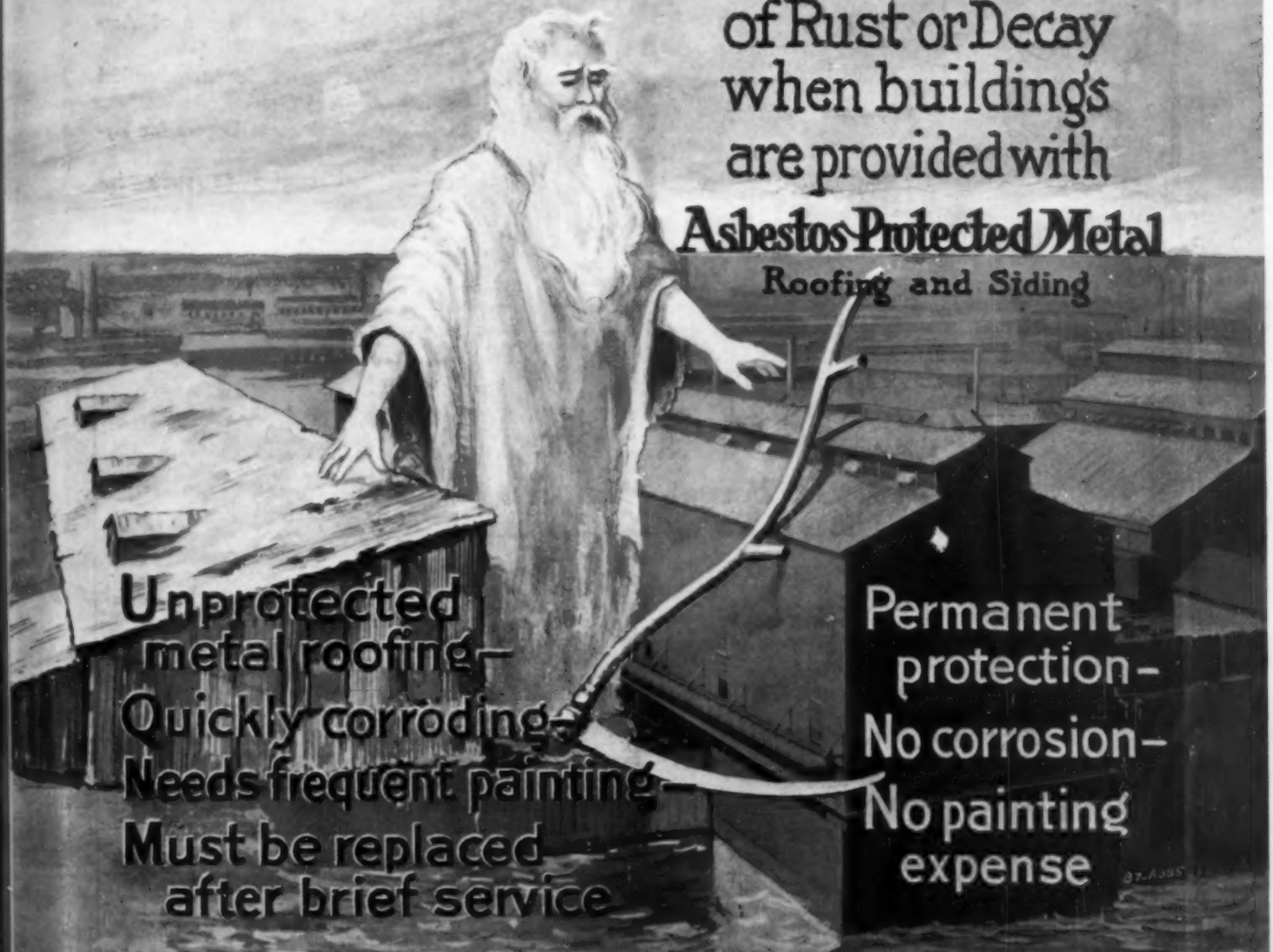

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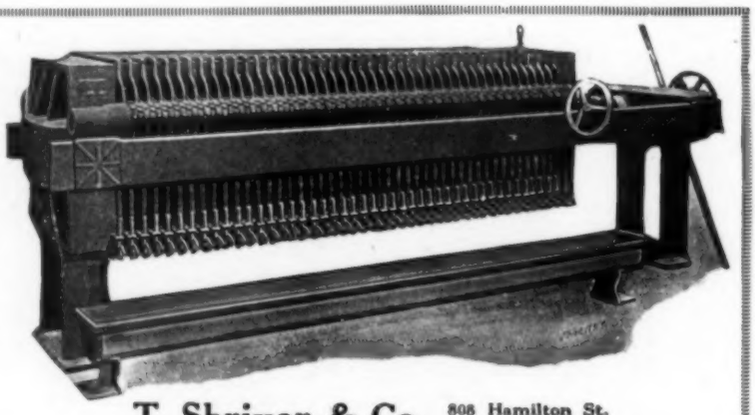

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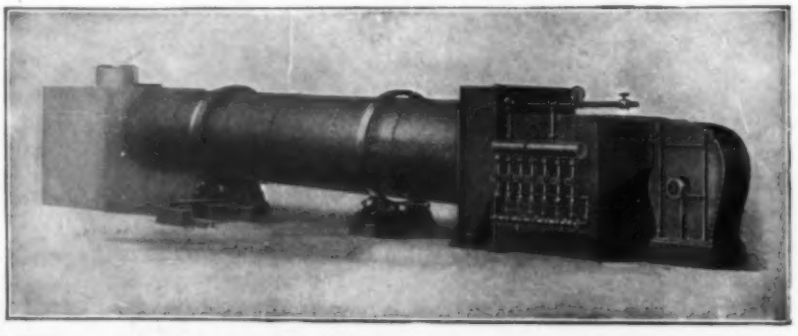

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J. MALCOLM MUIR, Manager

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What of Industrial Opportunities in France?

LIVE American manufacturers are speculating on the prospect of selling equipment and apparatus for reconstruction of industrial communities in Belgium and France. Naturally there is more or less groping about in darkness, but that condition is not confined to our manufacturers—even the French have not formulated their plans and they are in some confusion as to where to begin. The task is stupendous.

A few fundamental observations may be helpful. In the first place the devastated areas of France and Belgium must be reconstituted, beginning with that unit of society, the family. Scattered members of families must be brought together. Whether these families will then return to their former homes depends on whether the cities shall be rebuilt, and this in turn may hinge on the extent to which the industries once existing there have been re-established elsewhere. This may mean that existing communities will assume greater importance than some of those already destroyed. In any event the first problem is one of housing and food for the war-stricken people.

One obstacle to discovering what France needs is that no survey has been made to strike a balance between what has been destroyed and what has been replaced. The former is known quite well—the latter almost not at all. It seems as though our Department of Commerce should make or assist in making such a survey in the interest of our manufacturers. A difficulty is the scarcity of competent men. Another plan would be for associations of manufacturers to make their own surveys, sharing the expense. Individual concerns, of course, can cultivate the ground in their own private interest.

Something of that sort is necessary as a preliminary. France has not been conspicuous as an industrial nation, and there is no reason to assume that she will be. Perhaps the American manufacturer has little to look for in the way of European business and should turn his attention to South America. Certainly at present he should go slowly and investigate carefully. Some good advice is to be found in *Commerce Reports* for January 6 and 15, 1919, and August 27, 1918, which we commend to our readers.

Scrapping War Chemicals

EVERY once in a while we read that 280 carloads of TNT or hundreds of tons of mustard gas or an illimitable amount of phosgene or an infinity of chlorine has been dumped into the sea or is about to be cast into it. We have no actual confirmation of these harbingers

of destruction as final orders, but their persistence indicates that in the minds of too many unchemical Colonels and mystical Majors the idea prevails that chemical munitions should be destroyed because they were designed for a purpose which has ceased to exist. In this connection we do not refer to any unavoidable hazards to life, health or limb. Of course, these should be removed without cheese-paring in regard to the costs. What we object to is the sudden cessation of research, as though, now that the war is over, we do not need chemists or chemistry any more; or as though the job, being, as we hope, finished, everything should be scrapped or destroyed. This offends our business sense.

Our British cousins are keeping not only their scientific men but also those of signal ability in the administration of affairs at their posts, to aid in reconstruction. Our own Government, on the other hand, is letting too many of its valuable corps return to scholastic and industrial life.

If the rumors are true, it would be just as reasonable to throw the steel and other metals designed for use in shells into Chesapeake Bay because they will not be needed for war purposes. It has taken vast wealth and labor to prepare the store of war gases, and if the Ordnance Department does not know what to do with them, we suggest that the very able chemical staff which has accomplished so much in devising methods to prepare them be called upon to find new uses in the arts of peace. If, however, the War Department cannot bring itself to maintain its chemical service, there is the Bureau of Mines, which is a permanent institution. Although it is under the control of the Department of the Interior, Secretary LANE is not a man to be worried by red tape. Director MANNING has wisdom and understanding and we should cease to be anxious if the disposal of these things were placed in his hands. The chemical staff of the Bureau under Dr. PARSONS is not only exceedingly able and efficient but also thoroughly well administered. It has the facilities for research, and we hold that research is sorely needed.

Property should not be destroyed because it is a drug on the market. That is always bad policy. True, the substances are poisonous, but so is sulphuric acid and so is nitric acid; yet neither of these is thrown away when the market grows dull. The alkali cyanides have a well-established reputation for being poisonous, but that does not prevent them from being used in the recovery of gold. It is not good practice to run sodium cyanide down the drain, for prudential as well as for economic reasons.

Chlorine is indeed a problem, and new uses are needed in connection with the electrolytic soda industry. Nevertheless we shall not grow wise by dumping it. Its use is a problem in research which may find its solution in sewage disposal, or in any one of a considerable number of applications in industry or sanitation. Why not get busy in the Government research laboratories before the stuff is thrown away and the plants are dismantled? It is quite possible that within a year's time we shall be demanding chlorine with all our might and main.

We understand that Colonel WALKER has found an excellent market for phosgene, aside from its use as a solvent for ferric oxide to bleach sand for the glass industry. Shall it nevertheless be destroyed because it was made with intent to kill? It looks as though there were some uncontrolled legal talent at work in the Ordnance Department, which, coupling the intent with the substance, concludes that, the purpose being *non est*, the substance also should be made *non est*. We suggest that the authorities make Colonel WALKER a General, so that he may speak with the voice of authority before the remaining official pundits give military expression to their opinions.

Teach Engineering Students How to Study—First

STARTING from the oft-expressed idea "Engineers are needed as never before," many ill-considered schemes are being proposed and in some cases instituted to increase the output of our technical schools. Reduce the content of courses, graduate the men in three or even two years, or get a greater number of matriculants, is the net effect of most of the proposals. It is common knowledge that an unduly large percentage of the present graduates cannot be called engineers, in the true meaning. Yet the thought which doubtless has been given toward increasing the supply of real engineers by decreasing this proportion has so far brought few tangible results.

The boys presenting themselves for college entrance are largely volunteers. As human material they would delight a leader's eye. Properly handled they should successfully attack extraordinary difficulties. Yet an unconscionable number fall by the way, far short of the desired goal, their failure in good measure being due to improper preparation.

The average high school graduate is notoriously a "lame duck." Some of them are lacking in the mental and moral stamina necessary to attack and solve problems honestly. The high school shrugs its shoulders and blames this on home environment and pre-school training. Few indeed there are who can express themselves in correct English, or who can use applied arithmetic with a fair degree of success. But the high school blames these shortcomings on the grammar school. Who, then, is to blame for the fact that the pupils slip through the "cultural" and "humanistic" studies of the high school curriculum and at the end do not know really how to study, much less how to think?

But technical schools are confronted with a condition, and while it may do some good to point out on whom the blame should rest, their immediate problem is to turn their volunteers into engineers. Here are boys applying for a job on a four-year contract. Their chief work will be to think and study; to study hard and honestly, to rearrange thoughtfully their accumulated store of elementary facts in the proper phalanx to attack more complex problems. Yet they do not know how to study and to think, and, unbelievable as it may seem, no one makes an effort to teach them these fundamentals. Naturally, they continue with boyish abandon their carefree attendance to forms, such as going to lectures and carrying books to their rooms; but at other times they link arms with a happy chum and joyously trust to the lucky star which has brought them thus far. Sooner or later they discover the startling revelation that life is not child's play and they have indeed wasted golden hours.

One might profitably draw an analogy from like problems arising in intensified shop production. Machines could be bought but no men found to operate them; to put an unskilled man at them would certainly ruin the material, probably damage the machine, and very possibly injure the workman. Yet under the care of a competent instructor, an intelligent person could be turned into a successful operator in a very few weeks. Intensified individual instruction in elementary details solved the problem of skilled labor shortage.

If the technical schools would first teach their freshmen how to study and how to think, they would recover the time spent tenfold in later courses. Turning unskilled boys loose in college has resulted in a compromise of academic ideals, damage to the reputation of higher education and in many cases ruin of the boy's future expectations. More engineers of a sort may be had by shorter courses, fewer vacations and examinations, but more engineers of sorts may be had by preliminary and intensive training in the fundamental work of studying and thinking.

The Iron Map of Europe

PIG iron and steel do not grow, they are made—a fact that seems to be overlooked by those who have already sketched the iron map of Europe that is to obtain in future. Apparently they assume that the restoration of "German Lorraine" to France means that a quantity of pig iron and steel production corresponding to the 21,100,000 tons of iron ore produced by the territory in both 1912 and 1913 will be subtracted from the German production and added to the French production. It does not follow that because the territory becomes French again there will be an increase in French production of pig iron equal to the tonnage of iron ore formerly produced in it, and an increase in French steel production corresponding with such increased quantity of pig iron. These commodities must be made, they do not grow. The iron ore will probably be mined as formerly, but it remains to be determined who will smelt it into pig iron and who will convert the pig iron into steel.

The habitat of the pig iron and steel production will not be decreed by the Peace Conference, except as it may establish certain principles and rules, dictated by taking cognizance of economic, financial, metallurgical and engineering considerations.

Before the war there was a very complicated movement of the Lorraine or "minette" ores. The ores were produced in French Lorraine, German Lorraine and Luxemburg, and were consumed by these three countries plus Belgium. Some of the ores have an excess of lime, some of silica, and thus a certain amount of interchange over international borders was dictated by metallurgical considerations, while Belgium had to be supplied *in toto*.

France, however, while importing only 500,000 tons of ore from German Lorraine, exported to Germany more than 2,000,000 tons, of which half was consumed in Westphalia and the other half in German Lorraine and the Saar district, being attracted thither in limited quantities by the fuel. For a time during the peace negotiations, by the way, a contingent of the French set up a claim for the Saar coal basin, as requisite for the working of the ore, but this claim has been abandoned. Westphalia also consumed nearly 3,000,000 tons of ore mined in German Lorraine, and some of the pig iron produced by the Germans in Lorraine went to other districts of Germany for conversion into steel, while in general there was a flow of steel to more interior points for further working.

One does not know what individuals will own the ore mines, blast furnaces and steel works now in the territory that is to be transferred from the German to the French flag, but there is one thing that every one ought to know, that all Europe has got to work hard for years, and hence that all work that is done must be along the best engineering and metallurgical lines. If iron ore, or pig iron, or unfinished steel, or finished rolled steel needs to cross the new international boundary in order to accomplish the best economic results, that movement will have to occur.

In 1913 France produced 4,686,866 metric tons of steel ingots and Germany 18,958,819 metric tons of steel ingots and castings, both outputs being new high records. It is a simple matter to assume that the restoration to France of the aggrandized portion of Lorraine will add a certain tonnage to the French figure and subtract from the German. The arithmetical computation has indeed been made, and noting that the British capacity, with the completion of some work now under way, will be 11,000,000 or posibly 12,000,000 tons, the observation has been made that the three countries will be almost evenly balanced in steel production.

The French have a great deal of work ahead of them and they are very short of man power, while their financial resources are limited. No country has exercised more care to conserve its credit than has France, but that probably means conservatism for the future. The French will be well content if they can find full employment for their man, and woman, power and their capital. They will not set any certain mark, of 5,000,000, or 7,500,000, or 10,000,000 tons of steel production to be accomplished, but will endeavor simply to employ all their resources to the best advantage. In French Lorraine the blast furnaces and steel works have been destroyed or greatly injured, while the iron ore mines are reported practically intact. Restoration is needed, and this may possibly take more than a year. Some new steel works have been built during the war, and undoubtedly these will continue in operation.

It is easy to say that France will have such and such a steel capacity after the adjustments are made and assume that production will be in accordance. It would be still easier to say that the capacity of the United States is 50,000,000 tons, and accordingly assume that the United States will produce 50,000,000 tons each year, but the difficulty there would be that we are not doing it, and are in no way to do it in the near future. The fact that France is far away does not justify our taking liberties. The thing will have to be worked out, and iron ore mined in France, in reunited Lorraine, will probably pass to Germany, probably also some pig iron and perhaps partly finished steel, just as large tonnages of ore will continue to move into Luxemburg and Belgium.

New Jersey Chemical Society

THE third regular meeting of the New Jersey Chemical Society was held in the Wistaria Room at Stetter's in Newark Monday evening, Jan. 13. The evening opened with a banquet attended by 100 members, which was followed by the first "Rubber Night," with an attendance of more than 200 members and guests. Following the plan adopted by Dr. Calvert of the program committee, there was a scientific paper, read by Mr. George D. Kratz of the Falls Rubber Co., Cuyahoga Falls, Ohio, on "The Effect of Certain Accelerators on the Vulcanization of Rubber," which we expect to publish in a later issue. The popular paper of the meeting was read by Dr. Frederic Dannerth of Newark and was entitled: "Some American Substitutes for Rubber, From the Viewpoint of the Investor and the General Consumer."

Dr. Dannerth differentiated between artificial rubber, imitation rubber, synthetic rubber and rubber substitutes. In fact, some importers, he said, were inclined to import resinous gums under the tariff paragraph of "india rubber, free." The question of rubber substitutes, he continued, is of great importance because it involves our national welfare, and because the finest grades and most valuable varieties of rubber grow entirely outside the mainland of the United States. It is therefore most necessary and desirable to make an industrial survey of American raw materials and products which come into consideration.

The speaker enumerated 17 groups of materials, including raw oils; fats and waxes of vegetable and animal origin; sulpho-chlorinated oil products, called white substitute; sulphurized oil products, generally known as black substitute; sulphonated oil products of the type of turkey red oil; pitches and solid hydrocarbons obtained from petroleum, coal tar, asphaltum and fatty acid distillation; synthetic resins of the condensite type; natural resins obtained from spruce in the Carolinas, guayule in Mexico and chicle in Central America; carbohydrates, including starch and sugar; water-insoluble soaps prepared from lead, magnesium, aluminium, zinc and calcium; animal proteins such as glue and casein of cow's milk; and, finally, gums related to rubber. These include guayule obtained in Mexico from the parthenium shrub and chicle obtained in Yucatan from the achras tree.

Dr. Dannerth emphasized the fact that rubber and cotton are today "key materials" for the rubber goods industry, and no pneumatic automobile tires are made without rubber and cotton. Long staple cottons are being cultivated today in Arizona and the Imperial Valley, but high-tensile rubber is entirely absent as a natural resource. Virtually all plantation rubber is brought from the East Indies, a distance of 8000 miles, or from Brazil, a distance of 3000 miles. The per capita annual consumption of rubber goods in the United States is about ten pounds, which means that each person uses or obtains the benefits of ten pounds of all kinds of manufactured rubber goods each year.

"Will the rubber plantation owners repeat the $3 rubber market performance of April, 1910?" This was the question brought up for consideration by the speaker, in view of the approaching declaration of peace. The speaker also called attention to the statement made by one of the large plantation owners in the New York Rubber Conference in 1912 to the effect that he could, if need be, deliver rubber in New York City at a price close to 25 cents per pound. The London *Times* was recently quoted as saying that 80 per cent of the plantation rubber acreage is now under British control. But, Dr. Dannerth said, this should only serve to show that the British recognize the importance of controlling "key materials."

It was stated that the consumption of rubber in the United States in 1917 was 330,653,600 lb. of raw rubber and our annual imports of guayule rubber from Mexico are about 5,100,000 lb. Synthetic or factory-made rubber is a reality, but the cost of manufacture has not been cut down low enough for use during times of peace. This is the only material which possesses the peculiar properties of natural rubber, namely, the ability to gain in tensile strength and elasticity to an enormous degree by the process of vulcanization. But the substitutes for rubber possess many properties which rubber does not possess.

Annual Meeting of the Chemical Alliance

The second annual meeting of the Chemical Alliance was held in New York Jan. 23 to 25, at which time the question of the future of the organization was considered. Superseding the advisory committee on chemicals of the Council of National Defense, the principal function of the Chemical Alliance was that of a war agency to assist the Government. The need of an organization representative of American chemical industry is quite as great now and in the future as it has been in the past. Three important problems must be solved. The first relates to the urgent need for the validation of war contracts which involved vast expenditures on the part of the industry, but which, under stress of war, were not legally executed. Fresh legislation should be enacted speedily to enable the Government to take care of its moral obligations. The second matter demanding consideration is the re-sale of material bought by the Government under war contracts and to be resold as soon as practicable. The third question refers to the possibility of expanding foreign trade in chemical products. The directors announced that they would support the continuance of this organization in its present form and when the matter was put to a vote at the general meeting, there was unanimous concurrence. A special committee appointed to study foreign trade is expected to report its findings within two months.

Importation Restrictions Removed by War Trade Board

The War Trade Board announces that previous restrictions upon importation of chromite, monazite sand, manganese ore, copper ores, copper concentrates, pyrites, graphite or plumbago and graphite crucibles have been removed and that licenses will be issued for the importation of these materials from any country. It is further announced that with the exception of pig tin, tin ore and concentrates, the supervision heretofore exercised by the War Trade Board through various associations in the several trades over the distribution of raw materials in this country has been removed.

Sale of Surplus Materials and Scrap by the Ordnance Department

ALL surplus, unused or obsolete construction and manufacturing materials, semi-finished and completed parts, miscellaneous supplies, etc., left over at time of cancellation or termination of Ordnance contracts, or surplus at arsenals and supply depots will be ordered sold or stored as conditions require by the subcommittee on sale of material of the Salvage Board. The actual sale of this material will be handled by the material branch of the stores and scrap section of the Ordnance Department through the district stores and scrap managers, located in each district Ordnance office.

Capt. Ralph C. Shaw, chief, material branch, located in Group B, Section 1, Room 303 of the Ordnance building, at Seventh and B Streets, Washington, D. C., is compiling lists of the materials to be disposed of as promptly as these materials are reported for sale. Likewise he is compiling lists of buyers of given classifications of materials. This information is being imparted to the district managers. Any Government agencies or others interested in the purchase of any materials having been or to be ordered sold by the Salvage Board should communicate with the material branch.

All scrap left over from the operation of Ordnance contracts will be sold by the scrap branch of the stores and scrap section, operating through the stores and scrap managers of the district Ordnance offices. This scrap consists of different kinds of steel in sheets, billets and turnings, scrap steel parts, cupro-nickel scrap, antimonial, lead dross, silk and cotton waste, burlap, spent acids, etc.

District representatives of the stores and scrap section can give information as to scrap available. Likewise Lieut. Schleck, chief, scrap branch, Group B, Section 1, Room 305, will be glad to advise as to amount of scrap on hand at any point, price at which it is being held, etc. He will also be glad to receive names of Government agencies or other possible buyers of these materials.

Plans for close co-operation between the Government and industry in the sale of surplus Government supplies are also being worked out by the director of sales of the War Department and the War Service Executive Committee of American Industries. The policy of the Government with respect to the sale of supplies, as outlined by C. W. Hare, director of sales, will be to consult representatives of the industries concerned whenever sales are to be made in volume likely to disturb trade conditions.

The War Service Executive Committee consists of the members of the executive committee of the Chamber of Commerce of the United States, with the addition of others to make it more completely representative of all the groups of American industry.

Little Platinum in Black Sands

THE Bureau of Mines recently investigated the black sands of the Pacific Coast to ascertain whether there was a possibility of obtaining platinum therefrom. The results of the investigation may be summarized by the statement that in general the black sand deposits are disappointing in both value and quantity; they rarely contain enough gold and platinum or occur in adequate quantity to be exploited at a profit. There are, it is true, a few favored places where small areas of the black sand show some precious-metal content, and these may become the site of small operations. The deposits in many places contain appreciable amounts of magnetite, chromite and ilmenite, but these minerals are generally too scattered and too poor to constitute an important source of iron ore, especially in competition with the known deposits of magnetite on the Pacific Coast.

The chief difficulties in the profitable exploitation of these deposits are, first, lack of uniformity in occurrence and metallic content, and, second, the high cost of mining and treating the materials.

Black-sand mining in the past has offered a fruitful field for unscrupulous promoters and has been especially alluring to men having little knowledge of mining or mining methods. These swindlers usually claim to have some wonderful machine or process for extracting gold and platinum from the sands. Many of these agents made the most extravagant claims for the processes or machines. Some of these process men were so bold as to claim that they could recover gold and platinum where it could not be detected by any known scientific method. As a result the Pacific Coast is strewn with the wrecks of many kinds of experimental machines and of plants that bear evidence to the credulity and childlike simplicity of those who had been induced to invest their money in schemes for treating the sands.

Technical Paper 196, "Notes on the Black Sand Deposits of Southern Oregon and Northern California," has just been issued by the Bureau of Mines.

Copies of this report may be obtained free by addressing the Director of the Bureau of Mines, Washington, D. C.

New York Meeting of the American Institute of Mining Engineers

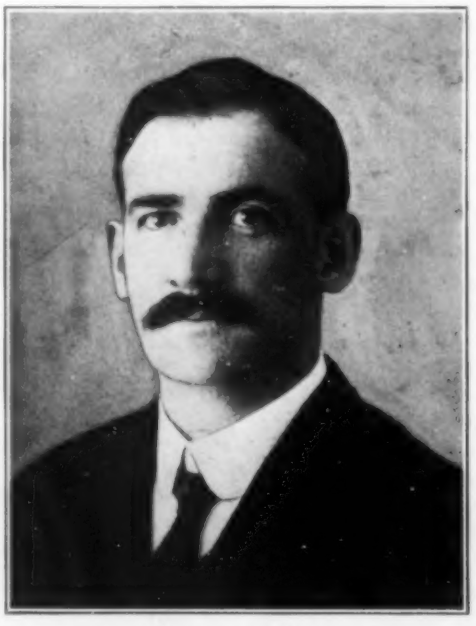
The one hundred and nineteenth meeting of the American Institute of Mining Engineers will be held at Institute headquarters, 29 West 39th Street, New York City, Feb. 17 to 20, inclusive. Technical sessions will be devoted to non-ferrous metallurgy and metallography, conducted by the Institute of Metals Division; industrial organizations; petroleum and gas; iron and steel; mining, milling and geology; coal; and electric welding, the last being considered at a joint session with the American Institute of Electrical Engineers. Tuesday, Feb. 18, has been designated as Canadian Mining Institute day, at which time there will be a discussion of international co-operation in mining in North America and uniform mining law for North America. A session of the National Research Council will be held Wednesday, Feb. 19, and on Thursday, Feb. 20, there will be an all-day excursion to the plant of the Federal Shipbuilding Co. at Newark, N. J., for the inspection of electrical welding of ships. Luncheon will be served each day at Institute headquarters. Social features of the meeting are a smoker, a travelogue by George Miller Dyott, late of the Royal Naval Air Service, and the annual banquet at the Hotel Biltmore. Special entertainment for ladies has been provided for by the Woman's Auxiliary.

Perkin Medal Presented to Frederick G. Cottrell

Award Made for the Recipient's Work in the Electrical Precipitation of Suspended Particles in Gases—Dr. Cottrell Describes Recent Work in the Commercial Production of Helium for Use in Balloons

THE thirteenth impression of the Perkin medal was presented to Dr. Frederick Gardner Cottrell, chief metallurgist of the U. S. Bureau of Mines, at a meeting of the New York Section of the Society of Chemical Industry on Friday evening, Jan. 17, at Rumford Hall. Major Charles E. Sholes, the honorary chairman, presided.

The hall was completely filled by an audience that represented a wide scope of chemical activity, both pure and applied, and messages of regret were read from the Secretary of the Interior, the Director of the Bureau of Mines, the Secretary of the Smithsonian Institution and others.



DR. FREDERICK G. COTTRELL

Joint Meetings Discontinued

Chairman Sholes announced that the joint meetings with the New York Section of the American Chemical Society, which the pressure of war-time conditions had made necessary, would be discontinued and that the meeting of the Society of Chemical Industry scheduled for April would be held as originally planned. On that occasion there will be made the first award of the Grasselli medal, founded by the corporation of that name and to be awarded each year for the best thesis which, in the opinion of the committee, suggests or records the newest or best helps or accomplishments in applied chemistry. The vice-chairman, Dr. Parker C. McIlhiney, offered a resolution of felicitation on the close of the war to be sent to the parent society, which was duly adopted.

Mr. Charles H. McDowell, the recent chief of the chemical division of the War Industries Board, spoke briefly of the satisfactory way in which the chemical industry of the country played its part in the war, and the fine spirit of co-operation shown by chemists and chemical engineers in meeting emergencies. The result was that our chemical accomplishment excelled that of many other industries.

Major Sholes' Remarks

Major Charles E. Sholes, chairman of the New York Section, in his introductory remarks said:

"Of course, it is always an honor and privilege to serve one's country anywhere. But the public seems to think that at least during this war it was not such a great honor to have served in Washington. Every man I know applied for field service abroad and was promised it and was bitterly disappointed not to get it.

"I suppose the answer is that some one had to arrange for the food, clothing, guns, powder, ships, etc., and to keep the books—and be the goat. So we have been striving to be very good goats. But it is perhaps fortunate that the men now in Washington have the saving sense of humor, else they could not have worked so hard and cheerily and proudly at their jobs. Just now they are telling a story of fifty years hence when our grandchildren are discussing the present war, and Mary says to John, 'Was your grandfather in the great war?' John says, 'Yes, he was in the Ordnance Department.' And Mary says, 'So was my grandmother!'

Pleased at the Honor

"Perhaps it is through such view of service in Washington that many of us are rather astonished and particularly pleased when any one in Washington is publicly honored—and gets away with it. So it is a great pleasure for me to ask the senior past president of the society, Dr. Chandler, to address Dr. Cottrell of the Bureau of Mines in Washington, D. C., and present the Perkin medal."

Dr. Chandler, who had previously received an ovation when he entered the hall, reviewed Dr. Cottrell's life and work, and presented the medal. His address follows:

Perkin Medal Presentation Address

By C. F. Chandler

"Mr Chairman and Brother Chemists:

"It is my privilege and very pleasant duty, as senior past president of the Society of Chemical Industry residing in this country, to present to Frederick Gardner Cottrell, B. S., A. M., Ph. D., the thirteenth impression of the Perkin medal, in recognition of his most original and valuable work in applied chemistry.

"Dr. Cottrell was born in San Francisco in 1877, where he received his early education. His degree of bachelor of science was conferred upon him by the University of California in 1896. He continued his scientific studies at the University of Leipsic, graduating in 1902 with the degree of doctor of philosophy.

"Returning at once to America, he became instructor in physical chemistry at the University of California,

later assistant professor. This position he held till 1911, when he joined the staff of the Bureau of Mines in Washington. Here he was at first the consulting chemist, then successively chief of physical chemistry, chief chemist, and finally chief metallurgist, which position he still holds.

"After graduating at the University of California, he continued his work there, devoting his attention to studies of hydriodic acid, liquid and gaseous, which enabled him to increase greatly our knowledge of the physical and chemical properties of this substance. His papers on this subject were published in the *Journal* of the American Chemical Society, 1896 and 1899, and in the *Journal of Physical Chemistry* in 1898.

"In 1900 he published a very elaborate investigation on manganous sulphate in the *Journal of Physical Chemistry*. This investigation was made with a view to throwing light upon the very interesting case of equilibrium in systems of manganous sulphate and water. His first publications while in Germany related to the genesis of some of the double and triple salts of magnesium occurring in the Stassfurth saline deposits.

"Dr. Cottrell's inaugural dissertation was entitled 'The Residual Current of Galvanic Polarization Considered as a Problem of Diffusion.' It was published in 1903. From this date on he continued to publish reviews and investigations too numerous for me to refer to here. Specially interesting are papers on liquid air plants, 1905 and 1906.

His First Fundamental Experiment

"Dr. Cottrell's most elaborate and valuable investigations relate to electrical precipitation of particles of liquids and solids and began in 1906 with his work on sulphur trioxide fumes which are not easily absorbed by water. It had long been known that electric brush discharges caused fog to clear. Sir Oliver Lodge had worked along this line. Dr. Cottrell describes his first fundamental experiment on page 5 of his paper on 'The Electrical Precipitation of Suspended Particles,' published in the *Journal of Industrial and Engineering Chemistry*, August, 1911.

"As this shows the beginning of one of the most important contributions to industrial chemistry, I feel that I can afford to consume two or three minutes of the time allotted to me to quote this experiment, from Dr. Cottrell himself:

> It may be of interest to note that the clue to the solution of this difficulty came from an almost accidental observation. Working one evening in the twilight when the efficiency of the different points could be roughly judged by the pale luminous discharge from them, it was noticed that under the particular conditions employed at the time this glow became appreciable only when the points had approached the plates almost to within the distance for disruptive discharge, while at the same time a piece of cotton-covered magnet wire which carried the current from the transformer and commutator to the discharge electrodes, although widely separated from any conductor of opposite polarity, showed a beautiful uniform purple glow along its whole length. The explanation lay in the fact that every loose fiber of the cotton insulation, although a relatively poor conductor compared to a metallic point, was still sufficiently conductive from its natural hygroscopic moisture to act as a discharge point for this high potential current, and its fineness and sharpness, of course, far exceeded that of the sharpest needle or thinnest metallic wire. Acting on this suggestion, it was found that a piece of this cotton-covered wire when used as a discharge electrode at ordinary temperature proved far more effective in precipitating the sulphuric acid mists, which were then the object of study, than any system of metallic points which it had been possible to construct. Perhaps the greatest advantage thus gained lay in the less accurate spacing demanded between the electrodes of opposite polarity in order to secure a reasonably uniform discharge.

"The first installation of his system was made at the Hercules powder plant at Pinoli, Cal., where there was a small contact sulphuric acid plant. There he used a 20,000-volt alternating current, rectified into a direct current by a motor-driven contact apparatus, and sent this current, by means of pubescent (hairy) asbestos electrodes, through the wet sulphur trioxide fumes and obtained precipitation.

Eliminating Fumes From Smelter

"This process, though successful, was not sufficiently profitable to warrant extensive use. It would probably have died had it not been that the nearby Selby smelter was in trouble. This smelter had a large plant near one of the tunnels of the Southern Pacific Railroad, and with certain winds the fumes of sulphur trioxide from the silver dissolving house would fill this tunnel with choking fumes, and finally legal proceedings were started to close the smelter plant. At this juncture Dr. Cottrell erected a small electric plant which met the difficulty completely and is running today, yielding dilute sulphuric as a by-product.

"But for the above-mentioned legal procedings the Cottrell process might never have materialized. The knowledge that fumes and smoke could be Cottrellized made the fume-pestered farmers all over the West sue the smelters right and left and satisfied the courts and juries that they were not asking the impossible of the smelters.

"The story of the Cottrell process for several years has been told in the news columns of the papers. Not alone has he taken the sting out of sulphuric acid waste fumes of smelters; he has brought down poisonous arsenic, saved metal dust otherwise going to waste, saved the orange groves from cement kiln smoke and recovered potash from that cement smoke to put on those very orange groves for fertilizer. The dust in the air, which was death to the trees through the clogging of the tender pores of their leaves, when duly Cottrellized and sacked and emptied on their roots, has given them new strength and life.

Extension of the Invention

"It would take a long time to give you a realizing idea of the marvelous extension of this Cottrellizing invention. I will content myself by giving you one example which I saw in the *Evening Post* of Jan. 11 last:

> Montana now has the tallest chimney-stack in the world, by a dozen feet, and in other dimensions it is immensely greater than its rivals. This is the recently completed stack of the Washoe reduction works of the Anaconda Copper Mining Co., which is 585 ft. 1½ in. in height. The outside diameter of the base, built in the form of a truncated octagonal pyramid, is 86 ft., and the walls are 5 ft. 4 in. thick at this point. The stack contains the equivalent of 6,672,214 common brick. Conducted through a vast flue system from the furnaces, the smoke will pass into chambers where will hang 111 miles of chains, electrified by a high-tension current. All the particles in the gases are electrified by contact as they pass through the links, and are vio-

lently repelled to be attracted by great plates between which the chains are suspended. These plates are grounded to form a negative pole. When they are thickly coated, the circulation will be diverted, the current shut off, and the accumulations will drop into hoppers.

"Dr. Cottrell's more recent work of investigation has had to do with the securing of helium gas for war balloons, which, being absolutely incombustible, is a wonderful substitute for inflammable hydrogen, while it is only slightly inferior in ascensional power. The helium is obtained from certain gas wells by liquefying out all the other constituent gases.

"I think I must cut my story short at this point and leave to Dr. Cottrell himself and Mr. Speed the pleasure of telling you of the Doctor's varied work at the Bureau of Mines and among the field experiment stations, as well as about the 'Research Corporation, an experiment in public administration of patent rights,' in which he takes such an active interest. I must say one more word: Dr. Cottrell has been granted many patents for his inventions and has generously donated them to the use of the public.

Conferring the Medal

"Frederick Gardner Cottrell, doctor of philosophy, my dear friend:

"It gives me the greatest pleasure, as the representative of the Affiliated Chemical and Electrochemical Societies of America, to place in your hands this beautiful Perkin medal, as a token of the appreciation and affection of your fellow chemists."

Cottrell's Work in Dewatering Oil

After Dr. Cottrell's speech of acceptance, printed in full elsewhere, Mr. Buckner Speed paid a tribute to Dr. Cottrell as follows:

"Dr. Cottrell has been, to those of us who have known him for the last fifteen years, a dear friend and gay companion. The fame and recognition that have come to him for the Cottrell process are less to us than the admiration we have for his unselfish character, his constant putting of his own interests entirely in the background and his remarkable imagination and his quick sympathy and helpfulness. On one occasion I remember his saying, at the completion of one of his larger pieces of work: 'Oh, I did not do much of it—I merely acted as a catalyzer to the boys who really did the work.' He has truly been a catalyzer to a host of us who have had the deep delight of working with him and coming in contact with his perennially fresh and keen imagination as well as his patience in the trying times that accompany all large efforts.

"This is the way the man's mind works: I recall some twelve years ago, when he was working on the precipitation of smelter smoke, I asked him for help on what seemed to be scarcely an allied problem—the freeing of California crude oil from its emulsified water. Instantly his mind worked with a snap: 'Why,' he said, 'it's the same problem. For air, put oil, for smoke particles, the minute water particles' and then his favorite form of expression: 'What will happen if we put a high electrostatic stress on the oil?' Then, in his characteristic quick manner, in a few minutes there were thrown together a beaker of oil, a spark coil and two pieces of copper, and lo! the de-emulsification of the California oils had been solved. Within a few minutes, on a block of paraffine under the microscope, there was spread out a drop of the emulsified oil, with two electric wires touching its edges. When the spark coil was put in operation the water drops were seen to arrange themselves in the field of the microscope like the iron filings between the poles of the magnet, to dance about and jiggle themselves into larger drops; and in these few minutes of experimentation the problem was solved by which millions of barrels of unmerchantable California oil were rendered fit both for refining and for fuel purposes.

"It was a familiar phrase to be heard in the University of California anywhere from the botany to the physiology departments when any question of any description came up: 'Oh, go over and talk to Cott about it—he doesn't know anything about the subject, but he will put some idea in your head before you have talked with him ten minutes,' and this he invariably did. This is the work he is now doing in Washington; and all over the country, wherever he touches an industry, there he leaves the germ of a thought that months later will come out as a manufacturing process. Such a man's work cannot well be measured by the achievements that have been credited to him."

Commercial Production of Helium

By Frederick G. Cottrell

MR. CHAIRMAN, Dr. Chandler, Ladies and Gentlemen: It is with a profound sense of appreciation on the one hand and of added responsibilities on the other that I accept this medal as a symbol of your approbation, friendship and confidence. I value the two former more than words can express, and this beautiful emblem will ever serve to keep clearly before me the responsibility to justify your confidence by striving to maintain unbroken the long line of high traditions of public service with which this award is associated on both sides of the ocean. I wish to thank you, Dr. Chandler, for this medal and for your kind words and, through you, the members of the awarding committee and the societies which they represent.

I am aware that it has been customary for the recipient of this honor to review the history of the subject particularly cited in the award, but the present year has witnessed the breaking of so many precedents and I have already on former occasions so thoroughly told you all that I know about electrical precipitation that tonight I shall take the liberty of dealing chiefly with quite another subject, though one which attracted my serious attention and study even earlier than electrical precipitation.

This is the industrial liquefaction and separation of the so-called permanent gases. My justification for this particular selection lies in the general interest at present in scientific problems whose solutions have been accelerated by the pressure of war needs, the case in point forming an interesting example in connection with the production of helium as a balloon gas.

Before turning to this, however, it may interest you if I briefly outline a few recent developments in administration of patents which, though not specifically referring to electrical precipitation, have to a certain degree perhaps been a by-product of the successful ad-

ministration of the precipitation patents by the Research Corporation.

Despite all the criticism which one hears of our American patent laws, I am disposed to look on them as remarkably satisfactory as far as they go and to feel that what is needed is not so much radical changes in the form and method of granting a patent as in the provisions for adequate administration, guidance and control in the interests of all concerned after it leaves the Patent Office.

Object of Research Corporation

The prime object to me in the formation of the Research Corporation was to furnish an experimental laboratory, as it were, in this most interesting branch of economics, and I have always looked upon the precipitation patents chiefly as mere kindling to start a fire under its boiler. If they have been able to generate some steam on their own account, it is of course gratifying, but that still does not distract my attention from the original aim.

The public's interest in the administration of patents has had surprisingly little attention when we compare it with other great problems of monopoly such as the railroads and the great fabric of corporate business. The patent laws as enacted in the early part of last century were entirely adequate to the simple structure of industry and economic life of the time, and it is amazing that they have functioned so well as they have through all the growing complexity ever since.

The attempt to work out in Congress sweeping reforms in the patent laws on the basis of our present knowledge would be a most difficult and even dangerous task, as well illustrated by the hearings on the Oldfields bill a few years ago. This is chiefly because we have little or no experimental data on what would happen if we tried by mandatory legislation to force at once on all patentees or their licensees and assignees new business methods which, although conceived in the most helpful spirit of fair play to all, would, when tried in practice, undoubtedly encounter innumerable unforeseen complications which might work great individual injustice besides actually hindering general industrial development. For this reason the somewhat unique sort of experimental work on patent administration purely in the public interest which the Research Corporation is doing appears highly important. Heretofore the study of patent questions has of necessity been approached almost wholly from the standpoint of one or other of the special interests concerned, such as that of the inventor, the patent bar or the large companies purchasing or operating under patents; while the broad, general interests of the whole public have not, as a rule, had the advantage of intensive continuous study and presentation by any agency wholly devoted to this purpose.

Interest in Patent Legislation

The most recent evidence of growing interest in this subject is a bill (S. 5265), introduced in the United States Senate on Jan. 2 by Senator Kirby, chairman of the Committee on Patents, which provides:

> That the Federal Trade Commission be, and hereby is, authorized and empowered to accept assignment of, or license under, to develop, to issue or refuse to issue licenses under, to encourage the industrial use and application of, and otherwise to administer, on behalf of the United States, under such regulations and in such manner as the President shall prescribe, inventions, patents, and patent rights which said commission deems it to the advantage of the public to be so accepted, as these may from time to time be tendered it by employees of the various departments or other establishments of the Government, or by other individuals or agencies; and to co-operate, as necessity may arise, with scientific or other agencies of the Government in the discharge of the duties herein set out.
>
> That the Federal Trade Commission be, and is hereby, authorized and empowered to collect fees and royalties for licensing said inventions, patents, and patent rights in such amounts and in such manner as the President shall direct, and shall deposit the same with the Treasurer of the United States; and of the total amount of such fees and royalties so deposited a certain percentum, to be determined by the President, shall be reserved, set aside, and appropriated as a special fund to be disbursed as directed by the President to remunerate inventors for such of their inventions, patents, and patent rights contemplated by this act as may prove meritorious and of public benefit.

This bill had its inception in the need felt for more adequate means of carrying the scientific developments made in the Government laboratories through to the public in their most useful and available form, and was sent as a suggestion in nearly its present form by Secretary Lane to President Wilson last August and referred by the President to the Federal Trade Commission for comment. During the war this latter body has administered enemy-owned patents in much the same manner and, therefore, already has much of the machinery and experience needed. The Commission, after careful study of the matter, reported favorably on the proposal, and one of the President's last acts before sailing for Europe was to send the bill with a strong recommendation to Chairman Smith of the Committee on Patents in the House, where hearings are soon to be held upon it. In the meantime, it has been introduced in the Senate to expedite its consideration by both houses. As the bill is attracting wide interest and no opposition seems to have developed from any quarter, its early passage is anticipated. This would be especially useful just now when the output of the Government's laboratories has been so increased by war activities and we are faced with the problem of dealing with many incidental discoveries and inventions coming therefrom, but having a predominantly peace-time significance.

What the Bill Contemplates

No matter how potentially valuable a purely scientific discovery is, it seldom benefits the public at large until it is carried through to industrial and commercial development and connected with the well-established avenues of trade. This is what the present bill is primarily intended to do. Incidentally also it automatically provides the expenses for its own administration as well as means whereby a modest pecuniary recompense may be awarded the discoverer or inventor of anything which through this channel eventually proves of material benefit to humanity. There are also signs of similar interest stirring in Canada and across the water, which it may be hoped presages a general and more active recognition of just these responsibilities on the part of government. It is, of course, particularly in the case of patents on broad fundamental projects that such an administration is of most importance to the public. The subjects both of electrical precipitation and that of liquefaction of

gases, to which we now turn, may excellently serve as suggestive examples.

The fact that my own connection with this latter work has been more from the administrative than the strictly technical or scientific side would make me hesitate to present it on the present occasion if it were not that looking back over the history of electrical precipitation a similar condition is evident, forcing me to the conclusion that even there my most useful services were in securing for the earlier fundamental suggestions of Sir Oliver Lodge and others the sympathetic consideration and practical large-scale development along lines of well-recognized engineering practice which they deserved but which had heretofore been lacking.

In 1904 it fell to my lot to set up and operate a liquid-air plant of the Hampton type at the University of California; and, in studying that installation, I became greatly impressed with the ultimate possibility of producing very cheap industrial oxygen by liquefaction and distillation of air, but was equally impressed with the very crude thermodynamics which, from a modern engineering standpoint, all the then common systems represented. Shortly thereafter I published two articles emphasizing some of these points and commenced experimental work along this line.[1] But pressure of other duties and lack of facilities prevented my carrying the latter very far. Ever since then, however, I have preached the importance of development in this field and have tried to follow up and post myself on each new attempt that came to my attention.

Quest for Cheap Oxygen

In assuming charge of the metallurgical division of the Bureau of Mines in 1916, it seemed that the quest for really cheap oxygen had become more than ever a large and legitimate part of my regular work; but, realizing my own limitations and the Bureau's inadequacy of material facilities, I strove to suggest, stimulate and collect inventions and developments rather than attempt to originate anything in this highly technical field.

In connection with the Bureau's laboratories at the International Exposition at San Francisco in 1915, we had already made a strenuous effort to interest the commercial oxygen companies in a co-operative experiment for the application of oxygen or enriched air to metallurgical furnace practice, largely in the hope of stimulating interest in the whole subject, but the project failed to receive sufficient support to be undertaken.

Oxygen as sold to-day in steel cylinders is so expensive that it usually fails to suggest even faintly the ultimate possibilities for low-cost production, in which latter case it would be of course simply piped at moderate pressure straight from the separating plant to the furnace. Thus, $200 a ton for even moderately pure oxygen is a very low price in steel cylinders to-day, whereas on the very large scale where unit cost of plant, overhead, sales expenses and the like are greatly reduced and compression into cylinders, transportation of same, etc., are completely eliminated, we come down to the power consumption for the actual separation as the largest and dominant factor of ultimate cost. Let us see what limits this sets. The individual steps in the process of liquefaction and separation of gaseous mixtures may all be made thermodynamically reversible to much the same extent in practice as are those of the steam engine and the air compressor. The chance for inventive skill lies chiefly in the selection of these individual steps from the alternatives long since clearly recognized and their combination into a consistent series. The difference in efficiency of present commercial processes resides in the acumen with which this choice and combination has been carried out and in the mechanical perfection of the apparatus in which the system is embodied.

The Problem

The final measure of theoretical efficiency is, of course, the degree to which reversibility in the thermodynamic sense has been approached. Air, for example, is only a mixture and not a chemical compound of oxygen and nitrogen and, therefore, no energy has to be supplied in its separation to overcome chemical affinity, but we do have to overcome what we may call the force of diffusion of the two gases in effecting their separation. In other words, we have to deal purely with that elusive second law of thermodynamics and not with the first. Thus, figured mechanically, the work necessary to separate five volumes of air at atmospheric pressure into one volume of oxygen and four volumes of nitrogen each at atmospheric pressure is simply that of bringing each of the partial pressures of the two gases as they existed in the mixture up separately to that of the original mixture. Or it is the work necessary to compress the oxygen from the five volumes at ⅕ atmosphere to one volume at one atmosphere plus that to compress five volumes of nitrogen at ⅘ atmosphere into four volumes at one atmosphere, all isothermally. Or, to put this even more concretely, if our heat interchanges and stills were thermodynamically perfect in their operation it would only be necessary to compress the original air isothermally to a pressure of approximately 10 lb. per square inch above atmospheric, to effect its complete separation into pure oxygen and pure nitrogen each at atmospheric pressure. Per ton of oxygen separated this figures out 60 hp.-hr. on the basis of isothermal compression. This is, of course, the theoretical limit for a perfect reversible cycle, which cannot be attained in practice, but we may hope to approach it to much the same degree that we have the corresponding limit in the steam engine and the air compressor, say 50 per cent as at least a legitimate goal for early endeavor. It seems doubtful whether any large scale air separating plants at present in service are greatly exceeding 10 per cent. But even 10 per cent would mean oxygen at a power cost of only 600 hp.-hr. per ton, which in itself should present startling possibilities to the minds of most chemists and metallurgists.

Magnitude of the Project

But why has there not been more actual development? This is chiefly due, I believe, to the very magnitude of the project, requiring as it does the closest co-operation and support of the whole undertaking from both

[1] "The Liquid Air Plant of the Chemistry Department, University of California," *California Journal of Technology*, Vol. 6, No. 1, pp. 1-11, Sept., 1905. "On Air Liquefiers," *Journal of Physical Chemistry*, Vol. 10, No. 4, pp. 264-274, April, 1905.

the users and producers of the oxygen. The transition from the present bottled oxygen stage of the industry to that of production directly at and as a part of the large metallurgical plant let us say where it is to be used means not only a complete redesign and development of larger production units but a complete reorganization of sales and business policy probably representing a licensing of equipment rather than manufacture and sale of product, a procedure which, to a well-established business concern, presents many drawbacks and dangers to its existing business. On this very account, the metallurgist on the other hand has never had the firm offer of oxygen in quantity and at a price to be within possible range of his operations except for such purposes de luxe as acetylene welding and burning out frozen tap holes; consequently he has never felt justified in the expensive development of oxygen or enriched air furnaces which, if successful, would in all probability necessitate very fundamental alterations in both equipment and practice.

Some Experiments in Belgium

Some experiments in this direction were indeed undertaken in Belgium before the outbreak of war, but were on an entirely inadequate scale to furnish conclusive results and, from the nature of the problem, its solution is bound to be an expensive undertaking, but one fully justified by the prospects of results attainable.

Let us consider for a moment the tremendous efforts already expended to concentrate up to the limit the ores and all the other raw materials entering a furnace and then remember that we are still adding the oxygen with four times its weight of inert nitrogen, all of which reduces the intensity of the chemical reactions and causes waste of valuable fuel, to say nothing of additional expenses due to excessive size of equipment.

But to return to the narrative. It was in March, 1916, that Director Manning of the Bureau of Mines handed me a memorandum of a conversation he had chanced to have in New York with some business men concerning a new process for air separation. The information had filtered through several non-technical hands until it had become more amusing than instructive; but, as it gave some definite addresses, I filed it with similar "clues to great inventions" and later tried to run it down to see if it had any foundation. The trail led me back with some little wandering to Mr. Fred E. Norton of Worcester, Mass., a graduate in 1891 of the Massachusetts Institute of Technology, who had since had responsible engineering experience pretty much all over the world, and I at once became interested in earnest.

Experiments Continued

His story for our present purpose begins with his leaving the position of chief designer of the turbine department at the Lynn works of the General Electric Co. in 1913, to enter the employ of Mr. E. A. W. Jefferies and undertake the engineering development of a process of air separation patented by the latter and which he had made arrangements with the General Chemical Co. to try out at one of their plants. After spending between $50,000 and $100,000 on this project the General Chemical Co. decided to drop it. Messrs. Jefferies and Norton then pooled their patents as the Jefferies-Norton process and, with the financial help of a few friends, continued experimental development in a smaller way for the next few years.

The parts of their process particularly attracting my attention were those Mr. Norton had introduced after cessation of the work at the General Chemical Co. and which radically changed the fundamental cycle upon which he in common with others had been working previously.

Scepticism Evidenced by Many

I found that, after making application for patents, they had discussed the work very freely with those who should be best able to judge of its merits and possibilities, but had made little progress toward securing practical and financial backing toward large-scale development. On attempting to investigate this situation, I found all sorts of impressions and rumors abroad as to just what the system really was. Many of those I talked with seemed to look upon it as a sort of perpetual motion scheme and were sure there was a flaw in the reasoning somewhere, although they had never run it down themselves, but understood that this one or that had done so. I had a good deal of work and not a little incidental amusement in following back to their source most of these clues and finally satisfied myself that if there really was anything fundamentally impossible in the cycle no one of those I was able to reach had been able as yet to put his finger on it.

Following our custom in the Bureau in such cases, an effort was made to put Mr. Norton and his associates in touch with people who might have sufficient use for such a process to justify their aiding in its further development, but for the reasons above cited I fully realized the difficulties and uncertainties in the way of definitely securing such co-operation.

Investigation in England

At the same time as the above development, but quite unknown to me, another thread of the present story was being spun in England. It so happened that Dr. R. B. Moore, now of the U. S. Bureau of Mines, had worked with Sir William Ramsey in his ever-memorable investigation on the rare gases of the atmosphere. Under date of Feb. 28, 1915, Sir William wrote to Dr. Moore:

"I have been investigating blowers, i.e., coal damp rushes of gas, for helium for our Government. There does not appear to be any in our English blowers, but I am getting samples from Canada and the States. The idea is to use helium for airships."

Importance of Helium for Airships

The importance of this proposed use of helium for balloons and particularly for airships of the Zeppelin type lies in the absolute inertness and non-inflammability of helium and the fact that it is of all known substances the next lightest to hydrogen, having about 92 per cent of the latter's buoyant effect. It also shows only about half the rate of diffusion and consequent wastage through the balloon fabric. As the fire hazard not only from incendiary bullets in war but also from atmospheric electricity and the Zeppelin's

power plant in both peace and war has constituted the greatest drawback to the development of lighter-than-air craft, it is difficult to overestimate what an available supply of this gas may eventually mean in the art.

At the time of the receipt of Sir William's letter the United States was not as yet in the war and nothing immediately came of the suggestion in this country. Dr. Moore remembered, however, that in 1907 Dr. H. P. Cady of the University of Kansas had found more than 1 per cent of helium in some natural gases from Kansas.

Dr. Moore's Letter

In a recent letter Dr. Moore says:

In April, 1917, when we entered the war, Sir William Ramsey was dead. Two or three weeks after war was declared, I attended a meeting of the American Chemical Society in Kansas City.[3] At the general session Mr. Seibel of the University of Kansas, who had been working with Dr. Cady, gave a paper on krypton and xenon in some of the natural gases of Kansas. At the end of his paper he expressed regret that at such a time, when every one was thinking of war problems, his paper was of a purely scientific nature and had no practical bearing on the war. I immediately got up and said that I did not agree with Mr. Seibel; as the presence of helium in these wells could, and should, have a very practical bearing on the war; as this gas could be extracted in quantity from the natural gas and used for balloons and Zeppelins. I pointed out some of the natural advantages of helium over hydrogen, and quoted Sir William Ramsey's letter. The general attitude of those present was one of scepticism, and I finally asked Dr. Cady for his opinion. He stated that he believed the thing could be actually done, but was very doubtful whether it could ever be made practical on account of the cost. At the close of the session Mr. Seibel came to me and asked if I really meant what I said, or whether I was joking, and I told him that I most certainly meant every word that I had said.

That same day I talked to Dr. Parsons, who was present at the meeting and who was returning to Washington almost immediately. I told him what had happened, and told him that I believed the matter should be taken up by the Bureau at once and presented to the War Department. He promised that he would do this as soon as he got to Washington; and I know that he did take the matter up with other Bureau officials.

News of Ramsey's suggestions also reached this country through other channels and eventually came to our attention. Professors Satterly and Patterson of the University of Toronto commenced experimentation on the subject Jan. 1, 1916. Col. G. A. Burrell, who headed the research department of the Gas Warfare Service at the American University, tells me that Cady's experiments had also suggested similar possibilities to him.

U. S. Balloon Service Interested

However, no definite step toward securing action seems to have been taken in the United States until June 1, 1917, on which date Messrs. Moore and Burrell, at the time both of the Bureau of Mines, called on Colonel Chandler, in charge of the balloon service for the Army, and explained the whole subject to him. He was intensely interested, at once realizing its potentialities and asked that a report be made to him, giving all available details. He also took the matter up with Mr. G. O. Carter, in charge of hydrogen plants for the Navy, who had had several years' practical experience in the Linde Air Products Co. with the liquefaction and separation of gases by their process. Mr. Carter also immediately appreciated the importance of the subject and urged this upon the attention of his superiors in the Navy.

Up to this time in the whole world there had probably not been more than 100 cu.ft. of helium separated as a pure gas and its price in the small lots in which it was sold was at a rate of about $1700 per cu.ft.

About this time I was called into the conferences and was much impressed by the weight which the British Admiralty apparently laid upon the cost of separation of the gas as a determining factor in its practical availability. I was given to understand that they had figures on the basis of the well-known commercial processes of gas by liquefaction and separation and were unable to see how production could be hoped for at less than $60 to $80 per thousand cubic feet, which they felt to be practically prohibitive for the program they then had in mind. It was at this stage that I suggested turning to Mr. Norton at least for a plan and estimate of what he thought might be accomplished along the new lines he had been following, and we accordingly wired for him. On Monday, June 4, we spent practically the whole day in thrashing out the subject with Mr. Norton, Mr. T. B. Ford[4], then in charge of the low temperature laboratory at the Bureau of Standards, and Mr. O. P. Hood chief mechanical engineer of the Bureau of Mines. As a result, Mr. Norton was asked to act as a consulting engineer of the Bureau of Mines and prepare plans and estimates for an experimental plant.

Dr. Moore then returned to his station at Denver; shortly thereafter I left on a several months' circuit of our Western experiment stations, and the supervision of the project for the Bureau of Mines devolved entirely on Mr. Burrell.

Appropriation Made for Work

In due course a formal report made by the Bureau of Mines was transmitted through Secretary Lane to the War Department, and although this report was as yet fragmentary and based on very inadequate data concerning the practical conditions to be met in the field, the Aircraft Board, on July 31, 1917, recommended an allotment of $100,000, half each from the Army and Navy, which became available for the use of the Bureau of Mines on Aug. 4.

A detailed survey of field conditions, to determine the best available supply of natural gas for the purpose, was at once begun, as also the preparation of working drawings for the experimental separation plant.

The general supervision of this was for a short period at this time placed in the hands of Prof. W. H. Walker of the Massachusetts Institute of Technology, who had come to Washington to assist in the chemical warfare work. I believe it was his suggestion, for purposes of military secrecy, to use the word "argon," as a code term for helium, in all correspondence on the subject, it being thought that as real argon is also an inert gas, but too heavy to be of any value in balloons, and is already used to a large extent in the incandescent electric lamp industry, this would serve as

[3]April 10 to 14.

[4]Mr. Ford not only rendered valuable service in these early conferences but took a most helpful and important part throughout the later stages of the work, both at the Bureau of Standards and in a trip he made to the plants in Texas and was engaged on this work when suddenly stricken down a few months ago with influenza. His death came as a shock to us all, terminating as it did a career of great promise.

particularly effective camouflage. This has in fact so effectively confused the two words in the public's mind that it will take some little effort to clear up the situation, and I would therefore bespeak your help in holding strictly to the true name helium whenever referring to the subject, now that all secrecy in the matter has been abandoned.

Even though we had been drawn into this work primarily through the desire of the British authorities to find a more economic process than those already known to them, it was now felt that the project had taken on such magnitude that the whole field should be carefully canvassed *de novo*. Mr. Burrell therefore next communicated with the two well-established operating companies controlling, respectively, the Linde and Claude systems of gas liquefaction and distillation, to determine whether it would be possible to work out a plan of general co-operation and pooling of information and facilities for this specific war purpose. Due to questions of trade secrets and other business relations, this did not, however, prove practicable, though both companies expressed themselves as anxious to co-operate individually with the Government and entirely willing to undertake independently the erection of plants of their own respective designs at cost, or even less, and have ever since most cordially furnished every aid in their power to make the work as a whole a success.

British Send Commission

At this juncture a special commission from the British Admiralty, headed by Commander Cyprian D. C. Bridge, arrived in this country to collect data and exchange ideas on what was being done, and from the resulting conferences the possible importance of the work in hand became so evident that the Aircraft Board on Oct. 17, 1917, recommended that a further allotment of $500,000 be made jointly by the Army and Navy to permit of immediately starting construction of complete plants under all three processes.

In accordance therewith, Mr. Norton was directed to prepare plans for a somewhat more complete plant embodying his process than had originally been contemplated as a first step. This brought the total estimated cost of the plant to about $150,000.

Norton Project Sidetracked

In making the actual allotment, however, the Navy placed a restriction upon its half of the $500,000 that none of it should be used on the Norton project. When this was called to the attention of the Army the latter decided to follow the Navy's lead, as they were very largely relying upon it for guidance and had designated Mr. Carter to represent them jointly in the matter.

Thus, while thoroughly realizing the expediency of the Navy's policy in making sure that the plants under established processes should be adequately financed and pushed with all possible rapidity to completion, the curtailment of support for the newer and more experimental portion of the program was a disappointment to those of us in the Bureau of Mines who had made a careful study of the Norton project and felt strongly as to the importance of giving it a thorough trial. The representatives of the British Admiralty also stated frankly that their main interest lay in the experiments on this process, as there was no particular doubt in their minds that either of the other processes could produce the gas, the only question being one of cost, and on this no one responsibly connected with either of the two old processes had been willing to even hold out any definite hopes of producing helium below the cost of $80 a thousand cubic feet, which the Admiralty at that time considered prohibitive for its chief purposes. The matter was consequently taken up afresh with the Aircraft Board and after considerable discussion that body on Dec. 11 recommended to the Army and Navy a further joint appropriation of $100,000 specifically for the Norton project. The Army immediately acquiesced with regard to its half but the Secretary of the Navy, feeling the need of further outside advice in the matter, requested the National Research Council to investigate the project with special regard to its theoretical soundness and its apparent chances for practical success.

Committee Appointed

The Council appointed for this purpose a committee of five consisting of Prof. Harvey N. Davis of Harvard University, Drs. Edgar Buckingham and Charles W. Waidner of the Bureau of Standards, Dr. W. S. Landis of the Air Nitrates Corporation and Mr. S. L. G. Knox, consulting mechanical engineer and later scientific attaché of the American Embassy at Rome. This committee after very careful comparative study of the three processes concurred in the Aircraft Board's recommendation of the additional $100,000, which was then immediately made available by the Army and Navy.

This was early in February, 1918, the controversy over the support of the project having delayed the actual starting of construction on the Norton plant by something over two months.

In the meantime contracts had been closed with the Linde Air Products Co. and with the Air Reduction Co. for the construction and experimental operation of a Linde and a Claude plant respectively, each for an estimated daily production of about 7000 cu.ft. of helium, and construction was well along on each. These plants were to be located at North Fort Worth, Texas, and operate on a natural gas containing about 0.9 per cent by volume of helium and of which the Lone Star Gas Co. was bringing some 20,000,000 cu.ft. daily through its pipe line from the wells at Petrolia, more than a hundred miles northeast of Fort Worth, to that city for domestic and industrial consumption.

After careful study of field conditions it was decided to locate the Norton plant at Petrolia in direct proximity to the wells, a procedure which had not been deemed practical for the two other plants on account of their larger demands for power and water supply.

Other Investigations

Parallel with the Bureau of Mines work on processes of extraction, Dr. A. F. Rogers of the U. S. Geological Survey undertook a recognizance of all natural gas fields in the United States with regard to their possible helium supply, as this might be judged from sampling and analysis of existing wells combined with a study of geological conditions. As the results of this study are expected to soon be issued as a monograph by the Survey, no attempt will be made to deal with them here.

The Bureau of Standards also undertook the determination of certain physical properties of the gases. More especially the latent and specific heats and specific volumes of methane over a wide range of pressures and temperatures, and the diffusion of helium through balloon fabrics.

In order to co-ordinate properly all the different agencies concerned, the conduct of the helium work as a whole was about this time placed in the hands of a committee consisting of one representative from each of the three departments chiefly concerned. Mr. G. O. Carter, as chairman, represented the Navy, Dr. Harvey N. Davis the Army, and Mr. Geo. A. Orrok the Interior.

Quantity and Purity Increase

The Linde plant, costing in round figures $300,000, was the first to be contracted for and have its construction started. It commenced operation March 6 and on March 22 produced gas containing 28 per cent helium. By April 21 this purity had reached 50 per cent, the yield being at first small, but both quantity and purity steadily increased up to a maximum daily production on Sept. 6 of 7755 cu.ft. of 67 per cent purity, with average production of say 5000 cu.ft. at over 70 per cent purity, which was then further purified in a second step to about 92 or 93 per cent purity.

The Claude plant, costing about half as much as the Linde, commenced production some weeks later than the latter, and has also gradually increased its production and purity of product. Although up to date these are still considerably behind the performance of the Linde plant, a new still is just being installed at the Claude plant which it is hoped will materially improve both yield and purity of the product.

Due to present pipe line limitations coupled with heavy consumption of fuel gas at this time of year, it has been necessary for some months past for the Lone Star Gas Co. to substitute for part of the Petrolia gas some from other fields carrying less helium, so that the helium content of the gas at present being treated at Fort Worth has fallen to between 0.4 and 0.5 per cent by volume, which proportionately cuts down the production at both plants.

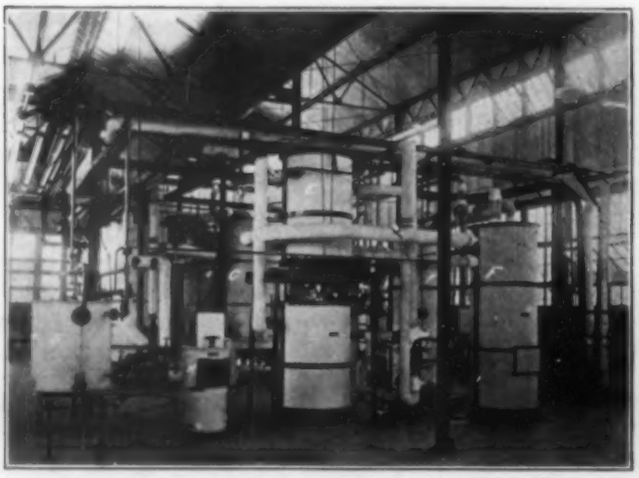
At the time of signing the armistice the first shipment of 147,000 cu.ft. of 93 per cent helium was on the dock about to be loaded aboard ship for Europe. This at the above-cited pre-war prices would represent about $250,000,000 worth of gas.

A large part of the credit for the promptness with which this actual production was affected is due to Mr. Carter, who was tireless in his efforts in pushing matters of priority, transportation, construction and production.

The Army and Navy have now jointly entered upon a larger production program under the immediate direction of the Navy, and have allotted some $5,000,000 for the purpose, including the construction of a new pipe line and additional units of the Linde plant at Fort Worth. General Squire, in an address before the American Institute of Electrical Engineers last week, stated that "Plants are under construction to give at least 50,000 cu.ft. a day at an estimated cost of not more than 10c. per cu.ft." If present expectations of the Norton process are fulfilled, this cost may be still further greatly reduced.

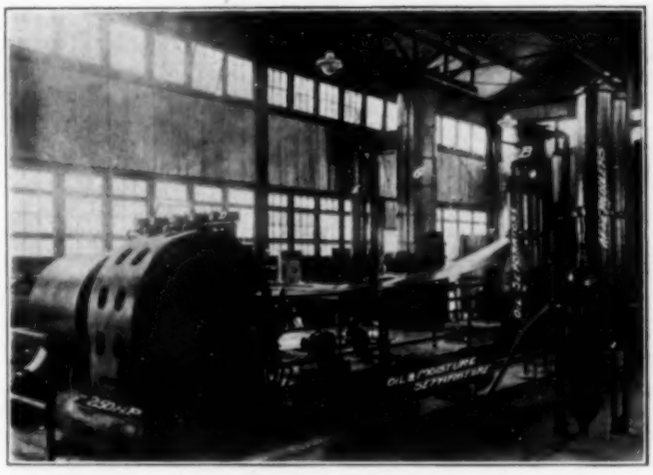
The Norton, or Bureau of Mines, plant at Petrolia was completed as far as initial construction is concerned the middle of October, and since that time its various parts have been successively undergoing tests and adjustments. The multi-tubular heat interchanges and large expansion engines, which were among the new departures in this plant, over which most anxiety was originally felt, have thus far worked out very well and now seem to be performing their allotted tasks to complete satisfaction. A good deal of difficulty was at first encountered by occasional floods of several barrels of oil and salt water coming over from the Lone Star Gas Co.'s gasoline extraction plant, which immediately clogged up the interchanges, making it necessary to shut down and go through the laborious process of thawing out the whole system and starting refrigeration afresh. This has now been eliminated by the installation of adequate settling chambers and traps, and tests and adjustments are proceeding upon the stills which form the last part of the equipment to be proven out. It is hoped that helium production will soon be attained, but as this plant has a rated production capacity of several times that of either of the other two, each change or adjustment in its parts requires rather more time even aside from the fact of the entire novelty and experimental character of many of its parts.

In studying the different systems of gas liquefaction

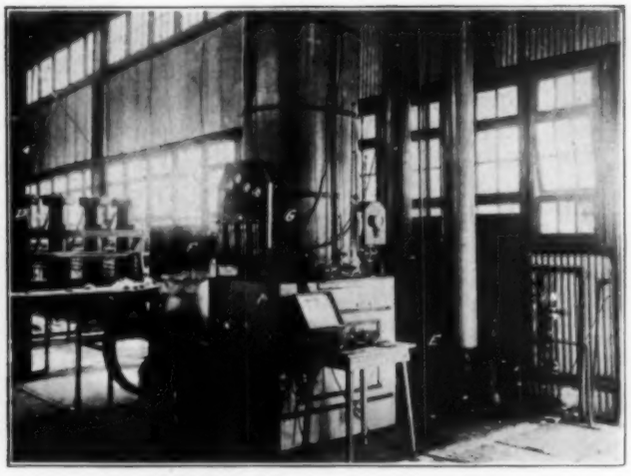


INTERCHANGE AND STILL ROOM OF LINDE PLANT

INTERIOR OF LINDE PLANT COMPRESSOR BUILDING



GENERAL VIEW OF THE CLAUDE PLANT AT FORT WORTH, TEXAS



D—HIGH PRESSURE PURIFIERS. E—HEAT INTERCHANGERS. F—EXPANSION ENGINE. G—STILL, ETC.

and separation it is very essential at the outset to distinguish clearly between the production of liquid as an ultimate product and the utilization of liquefaction and re-evaporation as a mere step in a separation where the ultimate products desired are still gases and at essentially the temperature of the original mixture fed to the apparatus.

In the former case a very considerable expenditure of work is represented in what we may colloquially term the refrigerative properties of the liquid delivered.

But in the second case, where the liquid is not drawn off from the apparatus and its amount therein remains constant, the part continually evaporating serves to condense nearly an equivalent amount of the incoming gases. Also the cold gases furnished by this evaporation take up heat from and cool the fresh incoming gas while they themselves are returning to room temperature.

Ideal Equal Pressure Process

Thus we may illustrate diagrammatically, as in Fig. 1[*], the continuous process of liquefaction and re-evaporation of a single gas. Ideal conditions would consist in perfect heat interchange horizontally between the two legs of the U tube A and C and perfect heat insulation lengthwise along each of these and from their surroundings.

If these conditions were fulfilled and the whole system once brought to a steady state by, let us say, refrigeration of the bottom of the U tube by some extraneous source of initial cooling while gas was slowly passed through it, we may imagine a certain amount of liquid condensed at the bottom of the U and a uniform gradient of temperature established along its two legs. Now, if the initial extraneous source of refrigeration were removed but gas still passed slowly into the system, the gas would progressively cool in A, liquefy at B, re-evaporate at B_1 and warm back to the atmospheric temperature in passing up C. Under these ideal conditions, with a single gas, the slightest imaginable difference in pressure between A and C should serve to perpetuate the process.

[*]The four cuts here shown are from a report made in the early part of this work by Mr. Norton to Mr. Burrell, outlining the problem in hand and the relation of the three processes to one another as they appeared to him.

Whatever heat leakage there is, however, either through the walls of the insulating chamber or down the legs of the U tube, represents a loss not of energy itself but of its availability for the purposes in hand; i. e., of thermodynamic potential, or an increase of entropy, if one prefers that terminology, the practical result being the necessity of expending mechanical work to compensate for these heat leaks. If, in addition to this, we are dealing with a mixture instead of a single pure gas, the constituents will in general liquefy and re-evaporate with varying ease, tending to set up temperature differences between adjacent parts of the two legs of the U and thus requiring a further expenditure of work to operate the cycle.

Looked at from the point of view of gas separation, the first of these effects represents pure loss, but the second is due, at least in part, to overcoming what we have above termed the force of diffusion in separating the gases and should thus be counted as useful work.

The problem is, therefore, to provide just enough refrigeration *at the proper temperatures and places* to cover these two demands after they themselves are reduced to as low a value as possible in the design of the apparatus and by use of the best heat insulation attainable.

The three systems for gas separation now before us differ perhaps most strikingly of all in the way in which they produce this refrigeration.

In the case of the Linde, Fig. 2, the gas mixture to be

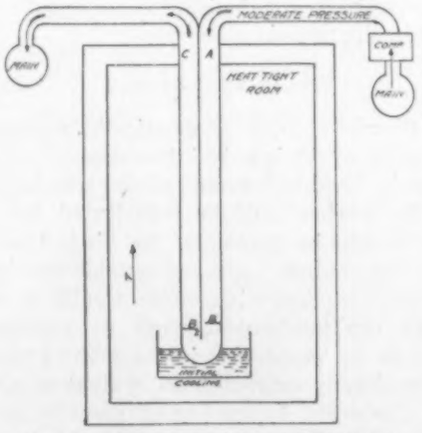


FIG. 1. IDEAL EQUAL PRESSURE

separated is pumped at very high pressure (say 1500 to 3000 lb. per sq.in.) into leg A and simply allowed to expand through a regulating throttle to a lower pressure at B_2 and return through D, the refrigeration being usually credited to the "Joule-Thompson effect." A discussion of this latter here would carry us too far into theoretical physics, but it may help the uninitiated in such matters to picture intelligently the general effect of this process to say that the specific heat of highly compressed gases is usually less than that of the same gas at lower pressure, so that a given weight of gas passing down leg A under high pressure in falling from one temperature to another will give up fewer calories

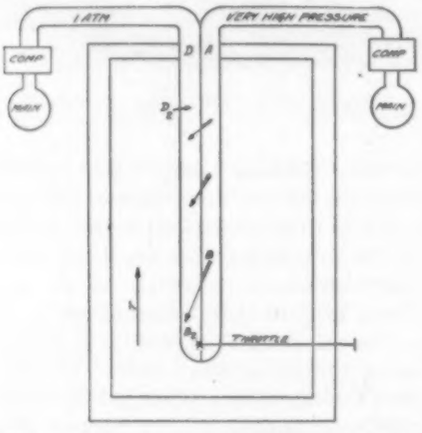


FIG. 2. LINDE SYSTEM, SELF-COOLING

of heat than the same weight of gas coming up the leg D will absorb between the same two temperatures. Thus it is evident that on the whole more heat will be carried out of the system by the issuing gas than is brought in by the incoming, with resulting refrigeration.

The fact that these differences of specific heat only become important at considerable pressures and the pressure created for this purpose is practically wasted at the throttle, as far as useful mechanical effect is concerned, makes this process decidedly inefficient from a thermodynamic standpoint; i. e., from the question of power consumption. Its chief merit lies in its extreme simplicity and freedom from moving parts. It is the type of system first developed both in the laboratory and commercially. As cooling proceeds, liquid finally forms at B_2. For the purpose of separating the constituents of the mixture the leg D is developed into a "column still" on the same principle as those used for rectification of ordinary liquids, but, to avoid confusion, not shown in the present cuts.

The Claude System

In the Claude system, schematically represented in Fig. 3, another principle is introduced. It was early pointed out by Lord Kelven and others that if some sort of expansion engine could be substituted for the free expansion throttle in systems of the Linde type and the work of these engines expended outside the heat-tight room, greater refrigerative effect would be produced even if all the mechanical work so produced were allowed to go to waste, for in its mere production it would have already extracted an equivalent amount of heat from this room. As, for the purposes in hand, these engines must work at very low temperatures, grave mechanical difficulties were seen in the problems of lubrication, brittleness of valves, stoppage by frozen impurities from the gas and the like. George Claude of Paris was the first to solve these difficulties, at least in a commercial way, and his book[5], recounting his experiences and discussing the general theory of the subject, is intensely interesting.

By use of an expansion engine, Claude was able to drop the initial gas pressure to from 400 to 600 lb. per sq.in., or even lower in some of the larger units recently erected for air separation. At these pressures the effect depended upon by the Linde system practically disappears so that, in practice, the Claude system works essentially on a wholly new principle rather than by the superposition of this upon that of the Linde process.

However, as Claude confined himself to one expansion engine[6], it was necessary for him, with his moderate initial pressure, to locate the engine's gas intake at a level in his interchanger sufficiently low so that the exhaust would reach the lowest temperature desired in the system and still be able to absorb quite an appreciable amount of heat at this temperature.

With the one engine taking its gas from the incoming side of the U, it is also evident that for efficient liquefaction only a part of the gas can be expanded through the engine, for, if liquefaction takes place in its cylinders, expansion to that extent is lost. The remainder of the gas must, therefore, be retained under pressure in the U and cooled down and liquefied by heat exchange with the expanded gas returning as indicated

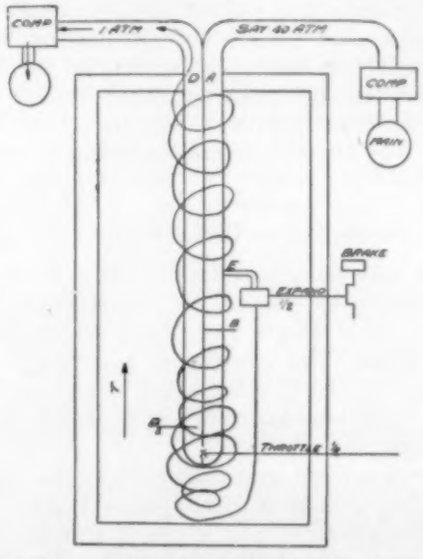


FIG. 3. CLAUDE SYSTEM, EXTERNAL WORK FOR COOLING

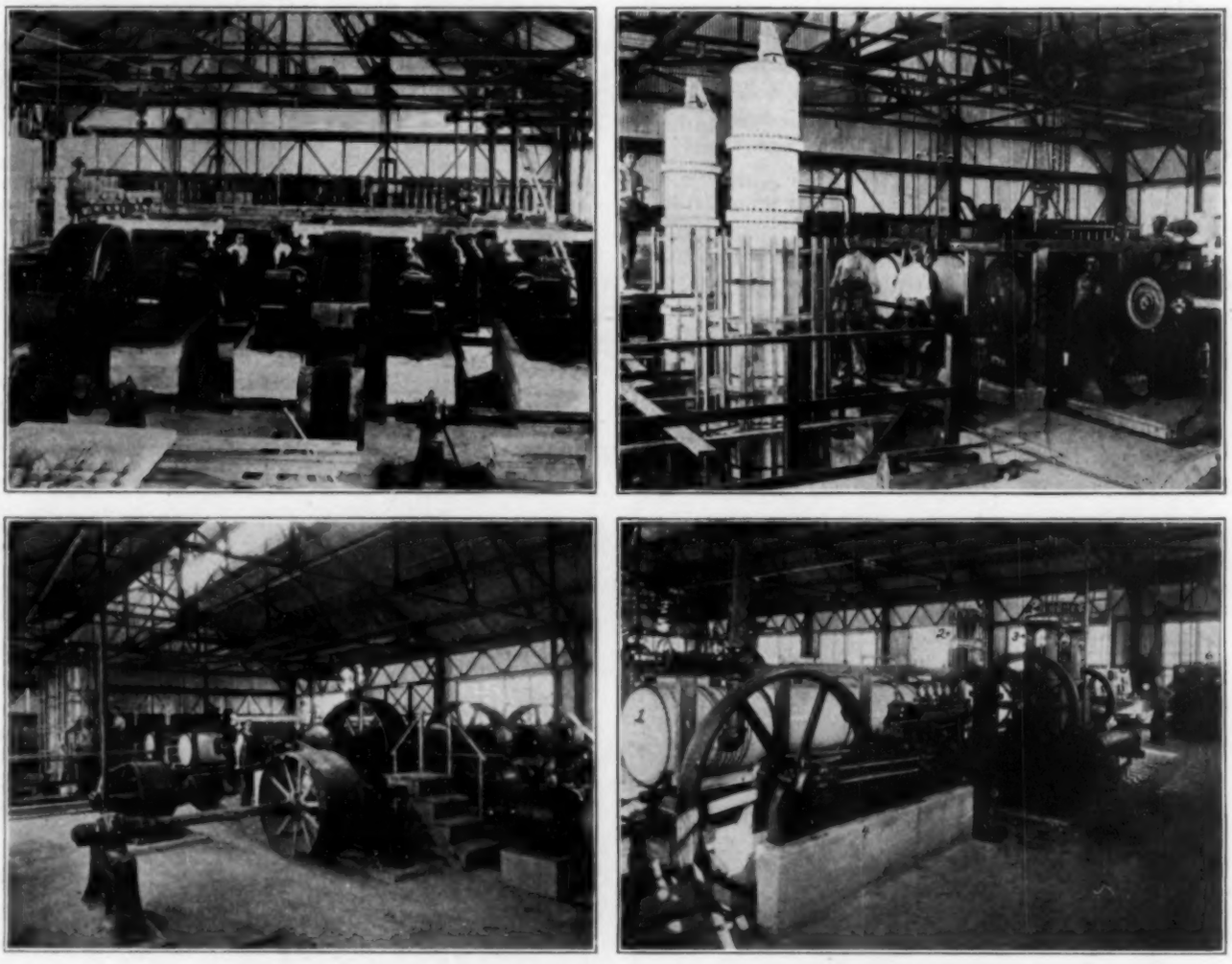
by the spiral line around both legs of the U. The gas after liquefaction in leg A is let into leg D through the throttle and there under the lower pressure rapidly drops still further in temperature by its own evaporation. Here it undergoes fractional distillation as already explained above.

The Jefferies-Norton System

Coming finally to the Jefferies-Norton system, Fig. 4, it will be noted that this differs from the Claude in

[5] "Liquid Air, Oxygen and Nitrogen," published by P. Blakiston & Co., Philadelphia.

[6] Though this is in many cases compound, having a high and a low pressure cylinder.



BUREAU OF MINES (JEFFERIES-NORTON) PLANT AT PETROLIA

Top left—Expansion engines. Top right and bottom left—General interior views. Bottom right—1. Interchanger. 2. Still. 3. Vacuum pump. 4. High pressure compressor for bottling finished gas. 5. Gage board. 6. Switchboard.

at least three important points, viz.: (1) The system employs more than one engine (in the illustration three, AE, BE and CE), each working through a different temperature range. The number of these temperature steps depends upon conditions, increasing with the total range of temperature to be covered and also with decreasing initial pressure employed. (2) The pressure in the outgoing leg of the U is only enough lower than in the incoming leg to allow for proper control of flow, unavoidable friction, head of liquid in the still trays and the like. (3) The engines work upon the gases after their liquefaction and distillation, thus permitting all the gas to be so treated. Incidentally, this also insures freedom from easily frozen impurities entering the engine valve chambers and cylinders and in many cases greatly simplifies the whole problem of initial purification of the gas to be treated. Engine C corresponds in a way to Claude's one engine system but as the initial pressure used in the system can, on account of its greater efficiency, be much less than in the Claude, the temperature range over which this engine works will be much less than in the latter. Since, when expanding a given weight of gas between two definite pressures, the work obtainable from it (and consequently the number of calories its expansion will extract from the system) is greater the higher its temperature, engine A will extract the most heat from the system and deliver the most power to the crankshaft per unit of gas used and engine C the least, which still further emphasizes the importance of this development.

Rough analogies, though suggestive, are often danger-

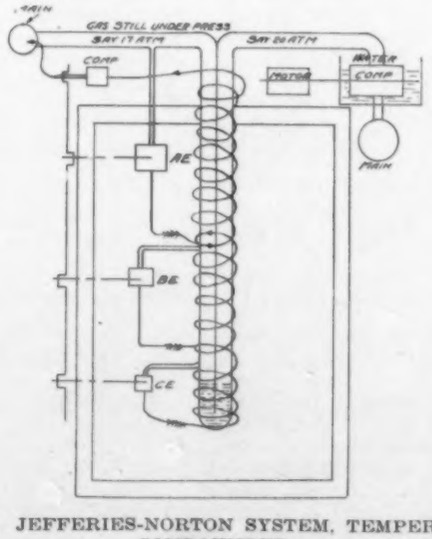


FIG. 4. JEFFERIES-NORTON SYSTEM, TEMPERATURE COMPOUNDED

ous to accuracy in scientific and technical explanations, but without laying any great stress upon it, the following may here be helpful to those not especially familiar with this subject. It was pointed out at the start that a considerable amount of the refrigerative effort which has to be expended in any of these processes is to remove the heat which, despite the best insulation we can put on the apparatus, still leaks in from without. Now in this sense the expansion engines of the last two processes may be thought of as engaged partly in pumping out this heat from the refrigerated system back to the outside, much as mine pumps are kept busy pumping out the water which leaks into a mine. Just as water may be coming in at various levels in the mine, so heat is leaking in to parts of the system at all levels of temperature. The one engine of the Claude system is analogous to the mine with a single pumping station at the very bottom where all water entering at any part of the mine is allowed to drain clear to the bottom and is then all pumped from there to the surface, while the Jefferies-Norton system is analogous to the installation of several pumping stations at different levels so that water from the upper levels is pumped out over the shorter lifts, thus saving power.

The really salient feature brought out in these diagrams is perhaps the progressive approach toward the ideal of thermodynamic reversibility and the high degree to which this is fulfilled in the basic principles of the last system.

* * *

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Aug. 13, 1912. Apparatus for separating suspended particles from gaseous bodies.

March 21, 1911. Process for separating and collecting particles of one liquid suspended in another liquid.

March 21, 1911. Separating and collecting particles of one liquid suspended in another liquid.

July 22, 1913. Method of discharge of electricity into gases.

Engineering Council Establishes National Service Committee

IN ORDER more completely to provide for united action upon matters of common concern to engineers, the Engineering Council has recently organized a National Service Committee and has established an office in the national capital at 502 McLachlen Building, 10th and G Streets, the office of M. O. Leighton, chairman.

The Engineering Council, through this National Service Committee and its Washington office, intends to accomplish the following general purposes, this committee acting always under the direction of the council and within limitations fixed for it:

1. To discover public services which may best be performed by engineering societies, and, when desired, to offer the proper men for such services.

2. To speak authoritatively for the Engineering Council before committees of Congress and departments of the Government on all public questions of common interest to engineers, within such limitations as the council may set from time to time.

3. To give promptly wide circulation among engineers to authentic information regarding pending legislation and executive actions which may affect the interests of engineers in any way.

4. To gather opinions of engineers on these matters.

The Engineering Council's aim is disinterested usefulness to the nation and the profession—not advocacy of any selfish ends—by giving unbiased information and counsel on technical matters, chiefly when asked. A modest start is being made. The work will be enlarged only as a real demand for services develops.

Meeting of American Institute of Chemical Engineers

Review of Proceedings of the Annual Meeting, Officers Elected—Advocate Adequate Tariff Protection, Anti-Dumping Law, Proper Means for Disposition of Government Stocks of Chemicals—Plants Visited—Our Chemical Industries Made Permanent, Webb Law, Open Price Associations

SUBSCRIPTION DINNER AT CONGRESS HOTEL

THE Chicago meeting of the American Institute of Chemical Engineers, Jan. 15-18, was in a number of respects the most successful ever held by this society. The keynote of the entire meeting was well expressed in the title of the symposium held on the opening day—"The Maintenance and Preservation of Our Chemical Industries." This is the most timely and vital subject at the present time which could be chosen for a meeting of chemical engineers.

The large attendance at the meeting indicated that the importance of the topic was realized by the members of the Institute as well as by the Chicago chemists and the chemical industries that sent representatives to the meeting. The United States Government was represented by Dr. Grinnell Jones, the chemist of the U. S. Tariff Commission. The attendance at the opening session of the meeting on Wednesday morning was about 100 and reached a maximum of about 250 on Thursday evening, when Col. Alfred H. White spoke on "The Present Status of Nitrogen Fixation" and Prof. Julius Stieglitz made an address on "The Manufacture of Synthetic Medicinal Compounds." The weather throughout the meeting was fair and mild. The increasing public interest in the chemical industries was shown by the amount of space given by the Chicago papers to the meeting and the presence throughout the entire meeting of a special representative of the *Literary Digest*.

The meeting was opened on Wednesday morning by President Thompson. The address of welcome was given by Mr. Leonard Busby, president of the Chicago Surface Lines. In welcoming the chemical engineers, Mr. Busby expressed as a business man his realization of the important part which the chemical engineer had played in winning the war and developing the resources of the country and the important problems still awaiting solution.

Officers Elected

During the business session the report of the canvassing committee showed that the following officers had been elected for the coming year: President, Arthur D. Little; vice-president, Prof. Albert W. Smith; secretary, Prof. John C. Olsen; treasurer, Dr. F. W. Frerichs; auditor, Dr. Charles F. McKenna; directors for three years, J. V. N. Dorr, Herbert Dow and Hugh K. Moore.

The secretary reported a membership of 306, which is an increase of 22 during the past year. Eight applications for membership had not yet been acted upon. The membership committee reported action on 19 applications since the last meeting. Several applicants had been rejected on account of insufficient chemical engineering experience or non-conformity with the code of ethics of the institute. The treasurer reported a substantial balance and $1250 invested in Liberty Bonds.

Prof. James R. Withrow, chairman of the committee on chemical engineering education, reported arrangements for having a copy of Dr. Mann's report on engineering education sent to all members requesting it. Prof. Withrow's committee will present a full report on this very important study of engineering education at the next meeting of the institute, when opportunity will be given to discuss the report.

The committee on meetings reported invitations from Boston, Atlanta, Providence and Cincinnati for the summer meeting with the recommendation that Providence be selected for the summer meeting and that a winter meeting be arranged for Atlanta, and that arrangements be made to visit the important industrial centers in that vicinity. The entire matter was left to the council with power.

After the business session the remainder of the morning, as well as the afternoon and the evening, was devoted to papers and discussion of the important topic, "Maintenance and Preservation of Our Chemical Industries."

The address of President Thompson was devoted to this topic under the title "Chemical Industries Made Permanent, and is given in full elsewhere in this journal.

Resume of Conditions

The next speaker was Maximilian Toch, who, with L. H. Baekeland as a special committee, had arranged the symposium and invited chemical manufacturers to send representatives to the meeting. Mr. Toch presented a résumé of conditions as they exist to-day in the chemical industries. He stated that more than 2,000,000 men and women are employed in the newer chemical industries. The need for tariff protection for these industries is shown by the fact that before the war the dye azo scarlet was imported and sold for between 15 and 20 cents per pound. To manufacture this dye in the United States to-day costs 85 cents per pound, which may possibly be reduced to 65 cents if the cost of raw material and labor is reduced.

Mr. Louis Matos, representing the National Aniline & Chemical Co., emphasized the great cost of developing the method of manufacture of coal-tar dyes and stated that it would be from three to five years before reliable data on production costs could be obtained.

Mr. Robert Hilton stated that the Ault & Wiborg Co. had invested a large amount of capital in the manufacture of dyes and that it would be absolutely impossible to meet the competition of the well-established German industries unless a much higher protective tariff were enacted by Congress.

Mr. William H. Rollin of the Rollin Chemical Co. discussed "The Future of the Barium Industry" and stated that this industry is still in its infancy and has not had time to become well established or financially strong. Freight rates will also be a determining factor in the future of this industry. While railroad rates are high, ocean freight rates from Europe may become so low that importation will be stimulated. Mr. Rollin stated that the survival of the barium industry was almost entirely dependent upon a protective tariff.

Mr. Colby Dill of the Perth Amboy Chemical Works maintained that the solution of the problem could be found in more and better research work being carried out on our chemical processes, employing for this work the chemists who have been released by the Government. Mr. Dill maintained that with good team work the American chemical engineer could meet foreign competition, as he has shown himself to be more resourceful and progressive than his foreign rival.

Advocate Anti-Dumping Law

During the general discussion of these papers a drastic anti-dumping law was advocated. The licensing system adopted by Great Britain was also urged as a very effective remedy. Under this system the importation of dyes and other chemicals is prohibited when domestic manufacturers can supply the market and importation is permitted only to the extent required to supply the domestic market with chemicals not manufactured in the country or of which the production is not sufficient.

Dr. Grinnell Jones, chemist of the U. S. Tariff Commission, read a paper on "Recommendations of the Tariff Commission in Regard to Dyes and Coal-Tar Chemicals." Dr. Jones discussed the provisions of a bill proposed by the commission to Congress making 45 amendments to the bill of Sept. 8, 1916, which established a tariff which encouraged the investment of capital in an American dye industry. The proposed amendments make no radical changes in the present tariff law either as to rates or classification, but merely correct some technical errors in the present law by which the evident intent of Congress is nullified. The tariff rates would therefore remain as at present, namely, 30 per cent plus 5 cents per pound on the finished dye, 15 per cent and 2½ cents per pound on intermediates, while the crudes are on the free list.

The Tariff Commission has no power to recommend rates of duty or to determine general policy as to high or low protection or free trade. These questions must be settled by the people. For this reason no material increase in tariff is likely until after the next Presidential election. The remedy therefore for the present predicament of the chemical industries is to be found in the reduction of manufacturing costs by the work of the chemical engineer and a change in the general economic condition.

Broad Reconstruction Program

Dr. Edward Gudeman in a paper on "Reconstruction Aspects of Some Chemical Industries of the United States" urged the adoption of a very broad reconstruction program. He advocated not only protection for our newly established chemical industries, but also conservation of our national resources, both material and human, by improving living conditions, giving employment to discharged soldiers and sailors, universal education in English, economic equality and development of our transportation facilities.

At the conclusion of the discussion a set of resolutions was adopted which had been drafted by a committee consisting of President Thompson, Secretary Olsen, F. E. Dodge, F. M. Dorsey, Edward Gudeman, A. H. Hooker, H. W. Kellogg, C. Bai Lihme, Louis Matos, S. W. Parr and Maximilian Toch. The resolutions strongly urged Congress to provide adequate tariff protection, enact an anti-dumping law and also so to dispose of Government stocks of chemicals that the market may not be demoralized.

A complimentary luncheon was served on Wednesday by the local committee to members of the institute and their guests. The local committee had also arranged for a smoker on Wednesday which was well attended and very much enjoyed by all.

Corn Products Co. Plant Visited

Thursday was spent in a visit to the large plant of the Corn Products Refining Co. at Argo, Ill. Two special cars had been provided by the local committee for transportation to the plant. The party of 54 was divided into small groups for the inspection. The following members of the company acted as guides: F. M. Sayre, superintendent; C. L. Soverign, superintendent of the refinery; Harry Reynolds, foreman of the starch department; Otto Sjostrom, research chemist, and Al Peterson. The plant is the largest of its kind in the world, the daily grinding of corn being 60,000 bushels, and $1,000,000 is being spent in improvements and additions to the plant on account of the increasing consumption of corn products.

The process of separating the constituents of the kernel of corn into starch, gluten, germ and hull was first shown. The starch house was then inspected. Here the raw starch is refined and dried. The sugar refinery was then visited where the starch in 10,000 lb. batches is converted by heating under pressure in the presence of muriatic acid into dextrine or dextrose. Part of the production of this department is glucose or karo and part is 80 per cent sugar, 250,000 lb. of sugar being produced daily.

The oil house was also visited, where corn oil is expressed from the dried germs by means of Anderson expellers. The oil is refined and sold as mazola. In the feed house all by-products of the plant are converted into cattle food. The power house was also visited and its excellent condition admired by the visitors. Automatic devices for operation, control and recording of performance had been installed wherever feasible. Electric power distribution was used throughout the plant.

Luncheon was served to the party in the commodious, well-lighted and well-kept employees' restaurant. The luncheon was identical with that served to the employees for 29 cents, which is the cost exclusive of rent and maintenance of the building. The luncheon was first-class in quality and quantity.

Welfare Work Explained

After luncheon Mr. F. M. Sayre, the superintendent of the plant, explained the welfare work being carried on by the company and the plan recently introduced for bringing about satisfactory relations with the employees. This plan included the election of an advisory committee of three employees in each department. All questions relating to working conditions in the department were brought before this committee sitting with the superintendent of the department. Appeal could be taken to a general committee elected by all employees of the plant, which met with the general superintendent. This plan had worked out very satisfactorily and the excellent relations existing between employees and the superintendent were very evident during the inspection of the plant. There are employed in the plant 1900 men and 600 women.

On Thursday evening Col. Alfred H. White gave a description of the nitrogen fixation plants which had been projected or erected by the Government. Lantern slides of some of these were shown. The plan decided upon contemplates the utilization of several of the nitrogen fixation processes which had proved commercially successful.

At plant No. 1, located at Sheffield, Alabama, synthetic ammonia was produced from nitrogen and hydrogen by a modification of the Haber process. The contemplated capacity of this plant was 60,000 lb. of ammonia daily, half of which it was planned to oxidize to nitric acid in order to produce ammonium nitrate. One unit only of this plant has been operated. The second plant, located at Muscle Shoals, utilized the cyanamide process and was designed to produce 110,000 tons of ammonium nitrate. This plant will be closed Feb. 1 until Congress shall determine what disposition shall be made of it. Plants 3 and 4 were located at Toledo and Ancor, Ohio, and were cyanamide plants. A 10-ton experimental plant had also been erected at Saltville, Va., to try out the Bucher process of producing sodium cyanide.

Prof. Julius Stieglitz then addressed the institute on the subject, "The Production of Synthetic Medicinal Compounds," Prof. Stieglitz explained how progress had been made in the study of the effect of specific organic groups or radicals on the human system and urged that more attention be given by chemists to this important field of research. He mentioned the production of synthetic adrenalin, which can be injected directly into the blood and which in 25 minutes will give effective relief to asthma patients.

Other Papers Read

At the Friday morning session the following papers were read and discussed: "Reinforced Concrete Tanks for Storing Ammonia Liquors," by F. W. Frerichs; "Concrete as a Chemical Engineering Material," by Maximilian Toch. In both of these papers methods of rendering concrete proof against erosion, chemical action, disintegration and decomposition were given. A paper on "Some Wild Engineering I Have Known" was read by David Wesson. A paper on "Chemical War Secrets and Manufacturers' Rights," by Edward Gudeman, emphasized the care which must be taken by Government officials not to divulge manufacturing secrets given them for war purposes.

"Belting for Power Transmission," by Ernest D. Wilson, brought out a very interesting discussion on this subject. Mr. Wilson presented the results of experiments showing that in most instances leather belting is the most efficient for power transmission.

After partaking of another complimentary luncheon furnished by the local committee, members and their guests proceeded by auto to the plant of the Lindsay Light Co., where the entire process of manufacture of incandescent mantles was shown. A new method had been worked out for the manufacture of thorium and cerium nitrates from monozite sand. The preparation of the fabric mantle, as well as the impregnation and burning off of same, was shown in detail.

The Underwriters' Laboratories of Chicago were then visited. The great variety of tests, both physical and chemical, which are carried out in this laboratory was

surprising. A great deal of interest was shown in the fire tests which were made on complete building walls cosntructed of various fire resisting materials.

The subscription dinner was held on Friday evening at Congress Hotel. About 60 covers were laid. The first number of the after dinner program consisted of several vocal selections by Mme. Myrna Sharlow of the Chicago Grand Opera Company.

Mr. Arthur Lowenstein introduced the well known poet and humorist, Mr. Wilbur D. Nesbit, as the toastmaster of the evening. The audience was kept in a roar by Mr. Nesbit's sparkling wit and humor. He first introduced Dr. L. V. Redman, chairman of the Chicago Section of the American Chemical Society, who spoke on "Why Is a Chemical Engineer?" "The Problems of the Chemist as Seen by a Layman" was responded to by Vincent Rockey of the research department of the *Literary Digest*. Mr. Rockey spoke of the great change which has come in American public opinion from indifference to intense interest in chemical topics. Dr. Grinnell Jones spoke of the work of the Tariff Commission. President Thompson was given the topic, "Chemical Horse Sense," and ingeniously drew many parallels and contrasts between the chemist and the most intelligent and faithful of domestic animals.

Secretary Olsen was called upon for a toast to "The Future of the Institute." While denying any ability as a prophet, Dr. Olsen asserted that if the institute did its work with the same energy and success displayed by the local committee in preparing for the Chicago meeting its future would be very bright. Speaking on the subject "Some Chemical Fakes I Have Met," David Wesson told of a number of very amusing incidents he had experienced.

On Saturday morning a number of the members visited the plant of the Standard Oil Co. at Whiting, Ind. This plant has been practically rebuilt during the last three years.

The number of ladies present at the meeting was not as large as at previous meetings, but those who were present were royally entertained. The program included a theater party on Thursday evening and grand opera at the Auditorium on Wednesday evening, as well as an auto trip through Chicago's park system. The ladies were also present at the luncheons on Wednesday and Friday and also at the subscription dinner on Friday evening. The members of the local section of the American Chemical Society participated in all sessions and functions of the meeting and materially assisted in making the meeting a success.

The committees were as follows:

General chairman, F. M. de Beers.

Finance Committee—A. W. Ayers, chairman; C. F. Hagedorn, G. N. Prentiss.

Entertainment and Reception Committee—F. W. Willard, chairman; C. B. Lihme, Edward Gudeman, Arthur Lowenstein.

Excursion and Transportation Committee—Harry McCormack, chairman; William D. Richardson.

Papers and Meetings Committee—L. W. Andrews, chairman; G. H. Pickard.

Publicity Committee—William Hoskins, chairman; P. B. Sadtler.

Ladies' Committee—Mrs. W. D. Richardson, chairman; Mrs. G. W. Willard, Mrs. Millner.

Our Chemical Industries Made Permanent

By G. W. Thompson*

DURING the last four years our chemical industries have had a wonderful opportunity to lay the foundation for a permanent development. This opportunity was occasioned through the cutting off of foreign competition and also through the abnormal demand created by war conditions. This period has passed and we are now on the threshold of another era, an era of readjustment, an era calling for the greatest intelligence and activity of mind if what already has been accomplished is to develop into a permanent industrial gain. To solve the problem of making our chemical industries permanent, it is necessary to study carefully the conditions that are confronting us so that means will be devised for properly meeting them.

There are certain things that can be eliminated from consideration at once. The production of chemical products having practically only war uses must cease. It is to be presumed that no one would advocate the continuation of wars in order that these products should continue to be produced. The proper study should, of course, be made to find out how the chemical products needed for war purposes can be used for peace purposes. It seems improbable, however, that much can be done in this direction. Of course much of the apparatus used in the production of munitions of war can be used in the production of those things needed in peace, and to that extent such industries can be modified and put, as it were, upon a peace basis. It is presumed, also, that in those industries established or developed for purely war purposes, a conservative policy has been followed so that the plants have been more or less paid for from war profits. If this conservative policy has not been followed, I know of no means of preventing financial loss. Such industries should take their losses and start in again on a new basis, manufacturing, if possible, peace products.

Let us consider now the problems that confront the manufacturer of chemical products for which there is a peace demand. We will attempt to list these problems and then proceed to analyze them more fully. As we see it, these problems are: first, how to meet foreign competition; second, how to correct destructive domestic competition; third, how to meet the losses which may result from falling prices, should falling prices come as is expected by many; fourth, how to meet the problem of high wages, with the probability of their also falling; fifth, how shall our chemical industries more intimately organize for peace production.

Foreign Competition

Judging by the expressions of opinion which have so far appeared in the chemical journals, foreign competition presents the most serious problem. The greatest difficulty, however, that arises in considering this problem lies in what we may expect under this heading. There are many diverse views. Some seem to think that Germany will, as soon as possible after peace is declared and the avenues of trade are opened up, commence to dump manufactured chemicals upon the markets of the world. German competition in the past has been considered unfair competition, and it is claimed, with-

*Address delivered at the Chicago meeting of the American Institute of Chemical Engineers, Jan. 15, 1919.

out contradiction and perhaps, on the other hand, without sufficient confirmation, that she followed the deliberate practice of selling goods under cost in certain markets until the local concerns supplying those markets were compelled to give up business, and when this result was obtained the price of the German product would be raised higher than the domestic product had been sold for. The Germans would continue to hold the market, as domestic manufacturers would not dare to recommence manufacture with the menace of the unfair German practice still existing as a possibility. The danger of Germany resuming practices of this kind is considered very real by many chemical manufacturers. How real this danger is we have no means of definitely determining.

Before the war international trade was essentially anarchistic; that is to say, each nation controlled, as it thought best, all questions relating to export and import; everything was permissible under international law. Import taxes could be raised or lowered by any nation as it saw fit. Each nation could lay down its own rules for import admissions. The nearest thing to a general rule which would remove international trade from the anarchistic class was such provisions in treaties in what are known as the most favored nation clauses. These clauses prevented any nation from discriminating against another nation protected by such a treaty in the matter of import or export restrictions.

Germany's Abuse of Freedom of Trade

Under these conditions, as has been stated, everything was permissible, and Germany was best known among the nations of the world for its aggressive abuse of this freedom in international trade. It has been claimed even, that if a manufacturer in another country attempted to follow the same practices as Germany followed, and shipped goods to Germany for the purpose of selling them in the German market at the market price or perhaps below it, he ran the danger that some quickly executed decree would prevent the entry of his goods into Germany, perhaps just at the moment when they had arrived at the German port of entry. An attempt by an individual manufacturer to break down this vicious German practice would, if successful, inure not to his benefit only, but would inure to the benefit of the other manufacturers in his own country and throughout the world. Partly to meet this situation, what was known as the Webb law was passed by our Congress, which permits manufacturers to combine for export business. This law was passed, however, too late to be of much use to American chemical manufacturers, as the war had started. As we are considering the problems now, and not presenting the solution, we will consider the Webb law further on when we are talking of this solution.

The danger of Germany becoming an acute and disturbing factor in international trade is increased by the prospect that Germany will be compelled to incur heavy bonded indebtedness held by foreign nations and their peoples. If Germany should largely become a debtor nation, she can only pay the interest on her debts by an excess of exports over her imports. The heavier the burden laid upon Germany in this respect, the more certain Germany is to become a competitor in the world's markets. Her gold will be drained from her and as soon as that draining has reached its practical limit, the only thing that she can then pay with will be the products of her labor. As she will need all she can earn to pay her taxes and indemnities and as these will increase her production costs, she may not be able to sell at prices that are menacingly low.

A Future Economic Problem

Couple with this the fact that during the war the United States has become a creditor nation and its credits and the interest upon them can only be paid, to a certain extent, in gold, of which apparently we have more than is good for us at the present time, and the remainder in merchandise, it can readily be seen that we are in danger of having goods offered to us at relatively low figures, not only by Germany but all other countries, these goods consisting at least to some extent of chemical products.

In order to give a true picture, however, of the situation, we must not neglect to look at the other side. German chemical industries, except for war purposes, have been almost at a standstill for over four years. Many of her plants must have passed into a condition of innocuous desuetude. Each of us knows what it means for a plant to be practically idle for four years. The plant itself deteriorates and the men on whom the successful operation of the plant has depended have become scattered, in many cases have died, and in all other cases, to a certain extent, have lost their art. It is hardly probable that the German chemical industries (speaking now with reference to peace products) are in anything like the good shape in which they were before the war. Furthermore, it seems probable that chemical research along peace lines must have almost ceased in Germany. In this country the reverse of all of this is the case. Our chemical industries have received a tremendous impetus. Men have become trained in chemical operations. Extensive chemical research has been going on in connection with peace manufacture.

Germany an Ishmaelite

There is another phase of this situation, too, that must be considered. Germany has become the Ishmaelite or the pariah of nations. Practically the whole world is wrought up with an intensity of feeling that will prevent the sale of her products if known to be of German origin. Think of this picture as portrayed by James Church Alvord in the New York *Times*:

> By rotting wharves her empty ships shall rock,
> Her slattern towns their poverty proclaim,
> Her high-towered factories topple block by block
> "Since "Made in Germany" is a brand of shame.
> Thrust from the door of Human Brotherhood,
> Misunderstanding and misunderstood,
> Beggared, unpardoned, excommunicate—
> The Ishmaelite shall wait.

If the picture is a true one, can we really have very much to fear from serious competition with Germany? If true, it indicates that Germany has beggared herself morally and physically, that about the only thing a German can do is to leave his native country, change his name and try to rehabilitate himself in other climes. Mind you, this picture is not one that I am painting, and I do not present it as a picture originating in my mind, but I do present it as a picture that is in the minds of a very large percentage of civilized peoples.

Assuming the very worst as to the dangers of German competition, what is the best method of procedure, utilizing implements at hand, for meeting such competition? I offer three practical solutions. The first of these is a combination of the chemical industries for export trade purposes, under the so-called Webb law; second, the formation, in the chemical industries, of what are known as Open Price Associations; and, third, the combination of chemical concerns which are not competitive and which are too weak to stand alone—by combining they would be strong.

Webb Law

This law, which went into effect April 10, 1918, has for its purpose the granting of permission to domestic manufacturers, sales agents, etc., to combine for the purpose of fixing prices and controlling export trade in the industries in which they are interested. The act starts off to define what is meant by export trade, which means solely trade or commerce in goods, wares or merchandise exported or in the course of being exported from the United States or any territory thereof to a foreign nation. The act is presumed to relate to trade outside of the United States or any of its possessions, such as Porto Rico, the Philippines, etc. In the act the word "association" is used, which is declared to mean "any corporation or combination, by contract or otherwise, of two or more persons, partnerships, or corporations." Evidently it permits a pooling of export profits, which is not permissible in domestic trade to the extent that it interferes with competition. To accomplish its purpose, the act simply declares that previous acts, including the so-called Sherman law, shall not be construed to apply to associations entered into for the sole purpose of engaging in export trade and actually engaged solely in such trade, provided such association does not "enter into any agreement, understanding, or conspiracy, or do any act which artificially or intentionally affects prices, in the United States, of the commodities of the class exported by the association, or which substantially, in the United States, or otherwise restrains trade therein." It also provides that the act creating a federal trade commission which defines and prohibits unfair methods of competition shall not be construed as to apply to competition in the export trade. It also calls for the filing with the Federal Trade Commission full details as to the association formed under the act, and penalties for failure to make proper reports. It also gives to the Federal Trade Commission power to initiate prosecution of associations that do not operate within the limitations of the act.

Aim of the Act

This act apparently will permit manufacturers, etc., to form associations that can do practically anything in export trade, so long as their acts do not restrain domestic trade or affect competition therein. It would appear that these associations could do things in export trade that would be considered unfair in domestic trade. Thus if any foreign country attempts to dump its goods on this country for the purpose of injuring domestic trade, the export association could retaliate by selling abroad its products, even at a loss, in order to prevent such dumping.

It is possible, however, that this phase of the act may be subject to the qualifications that the association's export sales are distinctly for the purpose of building up foreign trade and not for the purpose of interfering with domestic competition. However, an act of this kind will have to be interpreted as its practical applications develop. One thing is clear, however, that if associations are formed under this act before foreign goods can be dumped upon this market, and if these associations aggressively seek to develop our export trade in products which might be dumped upon our market, no criticism could be made, as it could not be shown that they had directly affected competition in this country or restrained domestic trade.

I do not know that I have made my point clear. Let me illustrate it. Suppose there is a certain product which our domestic manufacturers fear may be dumped upon our market. Manufacturers who are engaged in the production of this product can form an export association. If this association is formed in time and endeavors to develop foreign trade in this product before the same product made abroad can be imported, their act cannot be considered in any way illegal. It would also appear that they can continue to offer this product abroad on the same basis of price, etc., even after the foreign-made product was offered in this country. If, however, the association was not formed or did not commence to act until the foreign product had already been dumped upon this market, thereby depressing domestic prices, and they should then go into the foreign market for the purpose of preventing such importation, with the result that domestic prices would be increased, the association might be doing an illegal act. I am only attempting to give a common-sense view of this phase of the subject and it may be that my opinion is subject to revision by the mind legally trained. Also it would be manifestly foolish for me to give advice as to what should be attempted under this law in any particular case. Each case should be judged of by itself.

Pooling of Selling Interests

The main purpose of the act is undoubtedly to provide for collective bargaining in the export business. By collective bargaining is meant the pooling of selling interests so that those in the pool will not be bidding against each other, thereby depressing prices.

It is interesting to note that a number of associations have already been formed under the Webb law. Very few associations have so far been formed covering the chemical industries. It is presumed, also, that most of the associations so far formed have been for the purpose of providing collective selling, as in the case of the recent associations covering copper and steel, formed under the names of the Copper Export Association and the North American Steel Products Corporation. No one can tell to what extent the utilization of the Webb law will assist chemical industries. It certainly should, however, be studied by our chemical industries, both from the business and legal standpoint, so as to see how profitable use can be made of it. It would appear to be a very efficient instrument for the development of export trade and the meeting of foreign competition.

During the last few years a great many Open Price

Associations have been organized. Some few of them have been formed covering certain branches of chemical manufacture. Open Price Associations have for their purpose the bringing together of manufacturers of competing products, for the purpose of establishing trade practices and for the general welfare of the trade, to encourage a spirit of good will and mutual confidence among their members and with the trade, to co-operate with each other and with the Government authorities, to prevent unfair methods of competition and trade abuses, to study and adopt ways and means of eliminating waste in production and distribution, to establish and maintain standards as to quality and to induce truthful branding of products, to study manufacturing costs, devise scientific methods of accounting, and to furnish the members with useful information. All of these things an Open Price Association can do if it determinedly avoids anything like a reduction in competition or attempts to control prices. Apparently Open Price Associations have met with the approval of the Federal Trade Commission. One of the great evils they seek to correct is what may be described as the sporadic cutting of prices, due to misinformation as to what competitors' prices are. Thus, John Jones hears through the trade that James Smith is after a certain line of business and has quoted very low figures. In a great many cases the information which has come to John Jones is false and is not, under ordinary conditions, subject to verification. He simply has to guess as to what James Smith is doing, and, being fearful that James Smith may beat in the race, he becomes nervous and cuts his price to a figure in which there may be no profit or even a loss. Such a condition is ruinous to business; it serves no good purpose and is in the nature of unfair competition. If, however, there were some system provided whereby John Jones would know in due time exactly what James Smith was quoting, or vice versa, neither of them would be willing to go on record in making ridiculous quotations.

Two Methods of Procedure

This indicates the essential feature of Open Price Associations. To accomplish its purpose two general methods of procedure may be followed. One method is that each member of the association reports to its secretary all sales, the secretary in turn reporting these sales to all of the other members of the association. The other method of procedure is this: If all members published their price lists, they would then report to the secretary only deviations from the price list, the secretary then advising all the members of such deviations. The second method is one most easily followed with staple products.

Of course it is obvious that no Open Price Association of the kind described can exist unless the members of the association have a certain degree of confidence in each other. The simple reporting of prices or deviations from price lists will not accomplish much unless the members are honest in their reports. In other words, it is the spirit which develops out of such an organization that is its real value, the spirit of confidence. I presume that in the formation of these organizations, in some cases, the members have come together with the fear and trepidation which Ali Baba felt when he entered the cave of the forty thieves. After an organization of this kind has been in existence for a while, however, each one begins to be ashamed of himself for having thought so poorly of his competitors and he finds that after all he has no monopoly on honesty and that the other members of the association are not very much better or very much worse than he is. As time goes on he also finds that they are a great deal better than he ever thought it possible for them to be.

Right Spirit Must Prevail

The Open Price Association is not a cure-all, and unless entered into with the right spirit it undoubtedly could become a menace. The great temptation for the members of an association is to think that they are gathered together for the purpose of controlling or regulating prices, which of course is illegal. Those that appreciate this danger will studiously avoid any attempt at the control of prices. The association should not eliminate competition; it should not attempt to say what any member shall do with respect to prices. So far as I know, no Open Price Association has as yet been accused of attempting to regulate prices. Some time such an accusation may be made, but if so, every other association will, for its own safety, more strenuously stay safely within the legal line.

I urge upon the chemical industries the study of this proposition. I believe wherever an Open Price Association is established among chemical manufacturers the result will be better trade conditions, more uniform and more legitimate profits and a greater respect on the part of the consuming public. The cutting of prices below what will give a legitimate profit is not good for the consumer because in the long run what the consumer needs is stability in prices that are sufficiently low. He should not want an unfair advantage in the purchasing of goods, nor should he want a manufacturer to supply him with goods on which a reasonable profit has not been made.

Some Open Price Associations have considered the possibility of using their associations in the furtherance of export business. This is a legitimate development of the Open Price Association, although better conducted in associations formed under the Webb law. Whatever they may do in this respect, however, it is certain that in Open Price Associations there is an opportunity presented for the discussion of foreign competition. They can act collectively within certain broad limits to cope with this competition. They can conduct an advertising campaign in favor of domestic products. They can furnish each other with information which will enable them to manufacture more cheaply and so be able more easily to meet foreign competition.

The chemical concern that manufactures only one product, or only a few products, is at a great disadvantage as compared to a concern that manufactures a great many products. The uses of chemical products come and go, the demand for them rises and falls, new chemical products are discovered which are continually displacing those previously manufactured. The profits of a concern manufacturing one product, on being plotted, will show as a rule a very irregular curve. There may be frequent rises and falls; there may be a very rapid rise and then a very rapid fall. I think

if any large chemical manufacturing company had the information at hand and could plot its profits with regard to individual products, it would be found that these curves would be very irregular and, on the other hand, that if they were all combined, other things being equal, there would be shown a more nearly continuous and uniform curve that, with a well-managed concern, would steadily rise.

Widen the Base of Business

I am therefore laying down the rather fundamental proposition that concerns manufacturing chemicals should have as wide a base as possible in order to maintain their stability. I am probably offering nothing new in this suggestion; most chemical companies see the point involved and they have diversified their industries so that loss in one department will be corrected by profits in others. I am wondering if it is not true, however, that during our war period many concerns have gone into the manufacture of specialties without a broad enough base to give them permanence. Is not it possible that there are chemical manufacturing companies in this country that are on too small a base, but which, if combined with some other industry in a similar condition but manufacturing different products, would be able to weather the storm of competition? I am wondering if we have sufficiently learned our lesson from Germany in the diversification of our chemical industries. Are our manufacturing chemical concerns each as inclusive as the German companies in the number of products that they manufacture? Here is a path of progress that I am sure leads to profit.

Combines Suggested

It would be foolish, however, for a concern that is manufacturing one or a few products, to think that the only way for him to diversify his industry would be by increasing the number of products. Probably the best thing for it to do would be to combine with some other concern similarly situated but manufacturing other products. As I see it, there is nothing illegal in such a combination, as they were not competing. Of course, to a certain extent, even competing industries can combine, so long as the combination is clearly not one in restraint of trade, and the mere fact that some of the products of one of these companies are manufactured by the other company is no reason in itself why the two companies should not combine, unless by so doing they obtain a monopoly of product. I am not advocating such a combination. The combination I do advocate is only one which will result in the broadening of the base and the diversification of the industry. In many cases the by-products of one of the companies could be utilized in the manufacturing of the products of the other company, the economy thus resulting being a benefit to both and to the public at large.

If a chemical concern cannot hold its own in domestic competition, how can it hope to meet foreign competition as well? If it rests on a narrow base, how much more likely it will be to topple over in the struggle of foreign competition. By broadening its base it can withstand competition both domestic and foreign.

The danger of our chemical industries being injuriously affected by foreign competition would be very much lessened and in some cases would be entirely removed if our chemical industries made use of the three instruments I have outlined, to wit: Association for export business, under the Webb law; second, the formation of Open Price Associations; and, third, the diversification of industrial operations by such combinations as are possible without destroying competition. Individual initiative would remain intact in the case of all of these instruments and would not involve the asking for Government assistance.

Destructive Domestic Competition

Asserting that the elimination of domestic competition, so far as it is destructive to industry, can only be brought about by combinations which to a greater or less degree restrain trade, there are those who advocate the repeal of the Sherman law so as to permit combinations in restraint of trade. Personally I am opposed to any advocacy of the repeal of the Sherman law, primarily because I do not believe that it is a menace or that its repeal is necessary. Particularly is this true with regard to our chemical industries. I have already indicated how, to a certain extent at least, the evils of old-fashioned competition can be eliminated by Open Price Associations, and I have also indicated that the real need of our chemical industries is diversification through combinations that are not in restraint of trade. My principal objection to doing away with the Sherman law, outside of the fact that you could not get it repealed if you wanted to, lies in the proposition that nearly all progress is traceable to competition. If you destroy competition, you destroy individual initiative, which is the thing that above all other things should be developed. Forms of organization which appear to be logically complete but which after all substitute autocratic and bureaucratic methods for individual activity have in them the seeds of their own destruction.

To meet destructive domestic competition, all I have to suggest is the formation of Open Price Associations and the diversification of industries through combinations that are not in restraint of trade.

Falling Prices

One of the most serious things that appear to confront us today is high prices. If we knew that the present prices were to be maintained, that they would not drop back toward what they were before the war, we would have very little concern. We all know that there will be some falling off in prices, because war demands took up such a large supply of goods and labor as to force prices above their natural level. We may, however, be surprised and prices may not go back to their former level. Economists tell us that in general prices, after the Civil War, did not go to the level of what they were before the Civil War, and I venture to express the opinion that not for a very long time, if ever, will prices in general go back to the level they were before this world war. It would lead me too far to go into a discussion of the money question. The quantitative theory of money is pretty well established, and this theory teaches us that prices vary more or less directly with the per capita volume of circulating medium and whatever this circulating medium rests

upon. It is probable that the high prices in the United States are directly traceable, to a large extent, to the issue of Government bonds. These Government bonds are in the nature of extensions of credit, and extensions of credit are equivalent to an increase in the circulating medium. Germany has issued large quantities of paper money, and our associates in this great war have to some extent done the same. The Government bonds of our allies and our own country will form a basis of credit which, as I have said, is an increase of the circulating medium. High-priced labor means high prices for goods. If for no other reason, the resistance of labor to a reduction in wages will prevent, at least to some extent, a fall in prices.

For all these reasons I do not believe that the losses due to falling prices are going to be as great as some of us imagine. Of course the conservative business man has already taken care of this possibility, to a certain extent, by writing all of his inventories at low figures. How far he has been allowed to do this by the Treasury Department I am unable to say, but my understanding is that whether the Treasury Department would allow him to do this or not, in figuring his profits, it has allowed him to create such reserves as may be necessary to meet this condition. If reserves have not been created and profits have been divided on full war earnings, he is apt to be in a bad way and I know of no means of saving him without what would correspond to a surgical operation. If possible, reserves should be created in order to meet the possibility of lower prices.

High Wages

As I have already indicated, I do not feel that prices will fall very much or that wages will be very much lower. I am not considering here what we would want to do or what labor leaders want to do; I am only presenting my own diagnosis of the situation. If, however, wages do tend to go down, there will be something of a corresponding fall in prices. Each employer will have to consider the extent to which it is profitable to him to reduce his employees' wages. He has very little arbitrary power in this matter, but he can exercise a considerable amount of intelligence, and I personally believe that high-priced labor is more profitable than so-called cheap labor, although I do not mean by that that if you increase an employee's wages you thereby immediately increase his efficiency to a greater extent. I notice, however, that the men who are getting the highest wages usually get them because they are worth more than those who are getting less.

There will be a feeling of duty on the part of every employer of labor to take back those employees who have been in the Government service, finding positions for them as best they may. Many of these men who have served in the Army and Navy will come back with increased efficiency, unless indeed that efficiency is interfered with by injuries received. They will have a new view of life; they will be more democratic in their valuation of men than they were before. I am inclined to think that the men and women who have been in the service will have ideas that the intelligent employer cannot ignore. They will have become a political force of no small magnitude. Many of them have been fed by Uncle Sam better than they were ever fed before. In general their standards of living will have risen. The intelligent employer will not see his way clear arbitrarily to reduce wages. In view of these facts, the unintelligent employer, if he attempts to exercise his arbitrary power, will be confronted by strikes, without the support of public sentiment.

I do not know how to meet this problem of the wages of labor, except through a broad sympathetic spirit that says, "I may have to reduce wages and if I have to I suppose I shall, but as long as it is in my power not to do so, I will not do it."

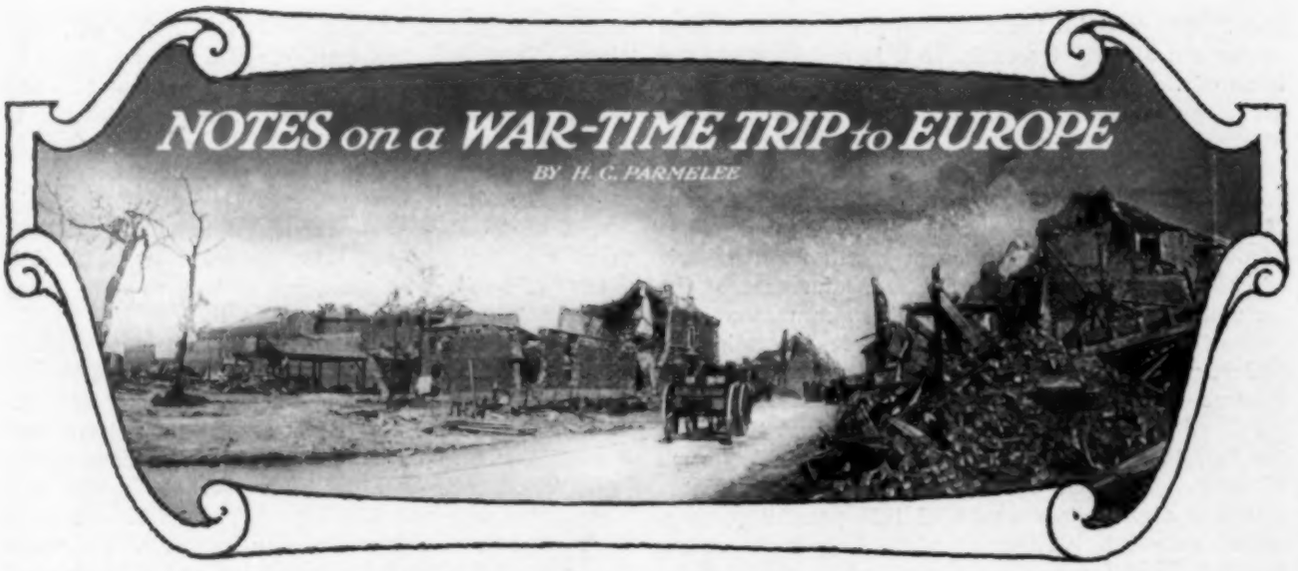
I make this suggestion simply as a business proposition. There are enough things confronting us to disturb business conditions and we should not seek for other forms of trouble. Undoubtedly there have been a great many employees discharged, with more to follow. There will be a large number of possible employees released from the Army. There will be a freer labor market. But many of our industries have been very short of labor for a long time and this shortage has not been met as yet. There may be no surplus of labor. The demands of the world for labor's products show no abatement. With peace production so much curtailed and with the awful destruction of wealth during the last four years, it would appear that the demand for industrial products would be great for some years to come.

Organization of Chemical Industries

I have already indicated how, under the Webb law and through Open Price Associations, our chemical industries can become more highly organized. There is little I have to suggest beyond this. I have only this thought to add. I know of no industry that is so continuously changing as the chemical industry. It cannot stand still. It must either go forward or backward. To go forward there must be co-operation between our industries and our educational institutions, there must be more chemical research and more active drafting of men of technical education into the commercial world.

In conclusion let me add this further suggestion. Opportunities very seldom come knocking at our doors. They are usually met in the course of our search for definite things. The recognition of opportunity when one meets it is a measure of intelligence. Particularly is this true in chemical industries. Opportunity presents itself in the unexpected discovery of new products and in the unexpected discovery of new uses for relatively old products. Very often opportunity appears at first in the disguise of failure. In general the success of any business, or we might say everything, depends upon its opportunities, but it also depends upon their utilization.

What the future holds in store for us is largely a matter of opinion and my opinion makes me an optimist. I am optimistic as to the opportunities that lie before our chemical industries. I am optimistic that our chemical industries are managed by men of so high intelligence that the opportunities that lie before them will not be overlooked. The world is in a state of flux requiring the greatest agility of mind if legitimate profits are to be extracted. This agility of mind I believe we possess. The future can only determine whether I am right or wrong.



Being a Journey of Observation in England, Scotland, Belgium and France With a Party of Editors of American Technical and Business Papers, at the Invitation of the British Government

ONE of the Great War's products in the United States was a fine spirit of co-operation and helpfulness between the Government and the technical and business press of the country; in fact, the relationship became so intimate and satisfactory that the press was looked upon as one of the strong arms of the Government in accomplishing its purposes. It remained, however, for Great Britain, through its Ministry of Information, to crown this local recognition of the business press by inviting a party of fifteen editors and publishers of technical and business papers of the United States to visit England and France in order that civilian intercourse among those nations might continue in spite of the obstacles interposed by military regulations. The following representatives comprised the party:

Horace M. Swetland, President United Publishers' Corporation, New York.

Arthur J. Baldwin, Vice-President McGraw-Hill Co., New York.

H. C. Parmelee, Editor CHEMICAL AND METALLURGICAL ENGINEERING, New York.

Henry G. Lord, President *Textile World Journal*, New York.

Roger W. Allen, President New York Business Publishers' Association, Inc. *American Hatter, Millinery Trade Review*, and *Nugent's—The Garment Weekly*, New York.

David Beecroft, Directing Editor of the Class Journal Co., New York.

H. L. Aldrich, Publisher *Marine Engineering* and *The Boiler Maker*, New York.

Samuel O. Dunn, Editor *Railway Age*, Chicago.

William W. Macon, Managing Editor *The Iron Age*, New York.

Floyd W. Parsons, Editor *Coal Age*, New York.

H. E. Taylor, Business Manager *Dry Goods Economist*, New York.

Frederick F. Cutler, President *Shoe and Leather Reporter*, Boston.

H. Cole Estep, Editorial Director Penton Publishing Co., Cleveland.

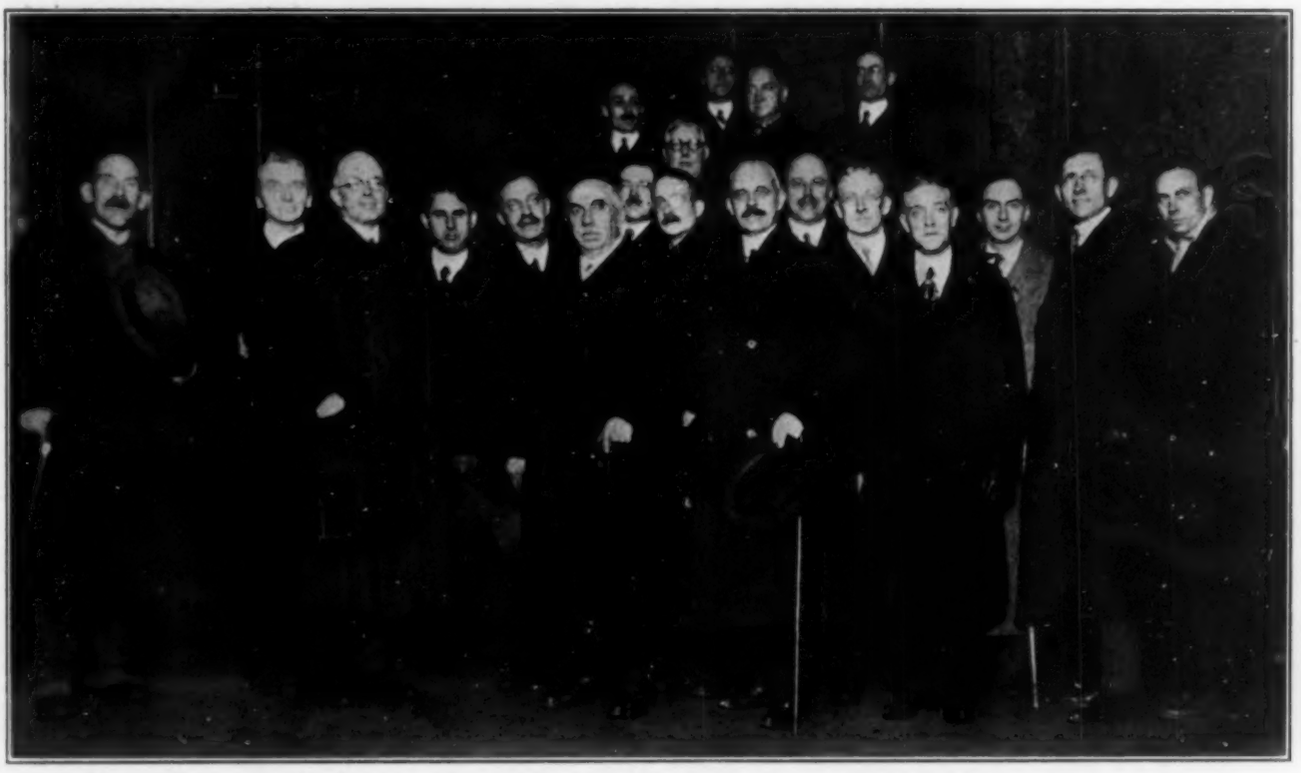
Allen W. Clark, President American Paint Journal Co., St. Louis.

Edw. H. Darville, *Hardware Age*, New York.

Sailing from New York on the S. S. *Lapland*, Oct. 26, 1918, we left the United States under all the conditions of secrecy imposed by military regulations. Our ship carried about 2500 troops, a contingent of the Army Nurse Corps, some British officers who had been assisting in the campaign for the fourth Liberty Loan, and a small group of civilians. About 4 o'clock in the afternoon we dropped down the river to the lower bay, where we joined a number of other ships, all camouflaged like our own, and anchored for the night. The following morning we were joined by still other ships, and about noon the great *Leviathan* steamed past us, loaded with thousands of troops. During the rest of the day we were treated to the impressive and spectacular sight of a great fleet of between 50 and 60 vessels starting across the ocean with troops, munitions and supplies, as part of the great answer America was making to the Kaiser's sneering taunt that we wouldn't fight.

DESPATCHING A FLEET TO EUROPE

The precautions for safety taken in despatching that great fleet to sea were a matter of astonishment to all. Hydroplanes, submarine patrol boats, captive balloons, a dirigible and several destroyers paid incessant attention to the departing vessels. The air and water were filled with these small craft scurrying here and there, guarding against any surprise attack from a lurking enemy. For several hours we were thus attended as we put to sea; and all this was accompanied by incessant signaling from ship to ship, by semaphores, pennants, wigwagging and flashing lights. Long before dark the



THE AMERICAN EDITORS IN HOLYROOD PALACE, EDINBURGH

fast *Leviathan* had disappeared over the horizon, and the balance of the fleet had spread out in fan shape extending as far as the eye could reach. One could be pardoned a thrill of pride in this evidence of the extent to which our great war machine was working in conjunction with the Allies.

During the night the great fleet must have separated into smaller groups of vessels, because the next morning we were in a small fleet of 14 troopships and freighters, convoyed by a United States cruiser and a destroyer. The fleet was formed roughly in column of fours, with the cruiser leading and the destroyer in the rear. Our course was changed a few degrees about every seven minutes, and thus we zigzagged our way across the ocean.

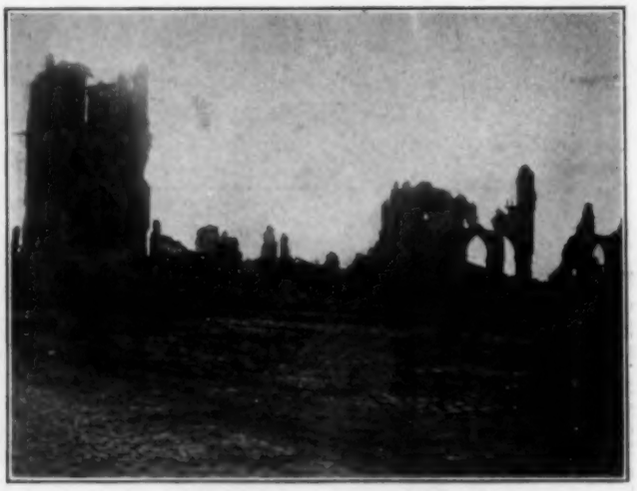
The rules and regulations for passengers were evidence of the unusual conditions surrounding our voyage. Life jackets were either worn or kept in hand at all times; we were not allowed in the dining room without them, and they were in evidence at card games in the social room or at divine service on Sundays. No lights or smoking was permitted on deck after sundown, and no passengers were allowed on deck after 10 o'clock at night. Guards were posted throughout the ship as in a military camp; submarine lookouts were stationed at points of vantage; guns were mounted fore and aft, and depth-bomb guns on either side of the ship. The life-boats were swung out of their davits ready to be lowered instantly, and rope ladders were provided at frequent intervals along the deck for use in case it became necessary to abandon ship. Numerous life-rafts and collapsible boats were placed on the upper deck, all provided with fresh water and provisions. All troops and civilian passengers were assigned to numbered life-boats, and a drill was held twice daily to familiarize us with the procedure in case of accident. The civilian accustomed to ocean travel in peace times would not recognize his surroundings or comprehend readily the habits and customs of the ship's company.

The voyage was without any spectacular incident due

A GERMAN TANK AND OTHER TROPHIES IN PARIS

CHATEAU RADINGHEM, HEADQUARTERS FOR VISITORS

LOOT FROM THE CATHEDRAL IN DOUAI



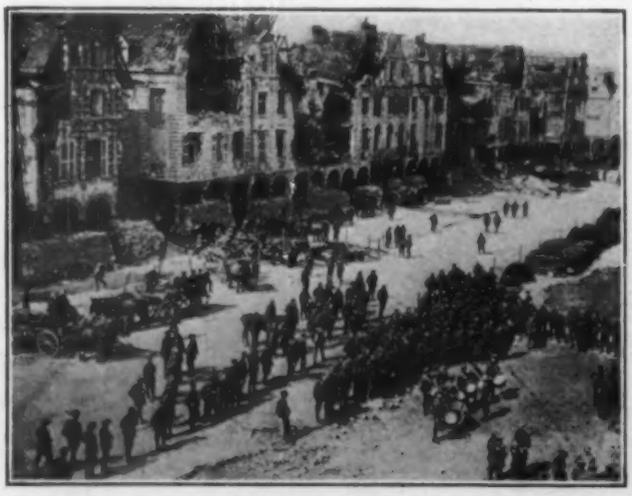
A SILHOUETTE AT YPRES

to the menacing submarine. On one occasion a ship dropped out of our fleet, due to trouble of some kind, and disappeared over the horizon to the rear, attended by the destroyer. On the following morning both were in their accustomed places. At another time, when we were approaching the Irish coast, our course was abruptly changed 180 degrees for an hour or more, when we resumed the original course. Naturally there was never an intimation as to reason for these things and we remained in ignorance of their cause or purpose. As a matter of fact, we know now that the submarine menace had been practically eliminated at that time. The convoy system and the depth bomb had rendered the submarine of no avail against their most important targets—troopships and freighters. Credit for both these ideas is to be given to Admiral Jellicoe of the British Navy, whose resourcefulness and ability in devising these means of defense were publicly acknowledged by our Admiral Sims at a dinner given in our honor in London.

Convoyed by British Destroyers

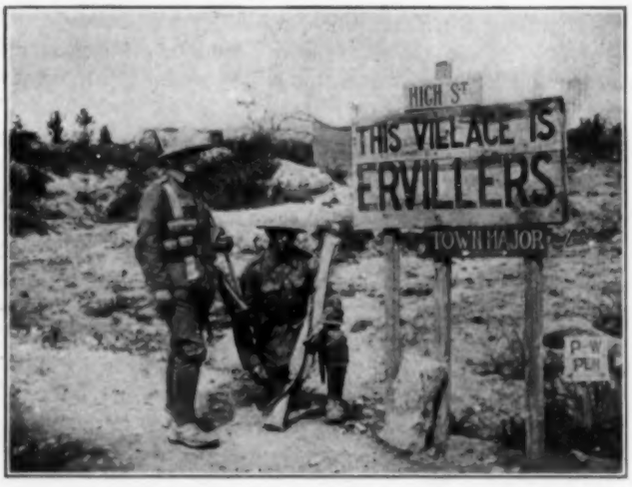
Approaching the Irish coast and the recognized danger zone, renewed precautions were taken for our safety. Troops were brought out of the hold and made to sleep on deck. Our own cruiser and destroyer turned back and left us, and we were picked up by eight British destroyers that convoyed us to Liverpool. The sea was heavy and these light small craft bobbed about like corks; and one was impressed with the discomfort that must attend life on such boats. In fact it began to dawn on our minds that the sailors navigating the coast patrols, mine sweepers, destroyers and merchant vessels have played a part in this war that will not be generally appreciated. Someone who knows should write the story of these heroes, their constant devotion to duty under the most uncomfortable and dangerous conditions, and their refusal to be intimidated or deterred from returning to sea even after they had been torpedoed one or more times. About 5000 small craft have been engaged in this work of coast patrol, mine sweeping and convoying, cruising at times a total of 6,000,000 miles in a single month, and providing throughout the war for the safe carriage from all ports and in all directions of a total of 15,000,000 men.

We landed at Liverpool on Nov. 8, after a voyage of 13 days. Here we were met by military representatives of the Ministry of Information, Col. E. L'E. Malone and Major George Whitmore. The latter was to be our guide, mentor and friend for six weeks, making easy our path through England, Scotland, Belgium and France; attending to passports, hotel accommodations, railroad tickets, taxis, etc., and securing for us many courtesies wherever we went. As a result of his



PUBLIC SQUARE IN ARRAS

REPAIRING THE MENIN ROAD, BELGIUM



MARKING THE SITE OF A DESTROYED VILLAGE

efforts we escaped many of the difficulties of travel during war times, as well as the necessity of reporting to the police on arrival at and departure from a city. Hotel registration, however, he could not relieve us from, and it was always necessary to give our intimate personal and family history at each new hostelry.

Conditions in London

At Liverpool we were provided with a special car on the London & Northwestern and went directly to London, arriving there about 10 o'clock at night. Here we encountered new precautions for safety from German attack—this time from the air. London was dark. An occasional street lamp was lit but masked with paint, and taxis carried only a dim light. Illuminated red signs at frequent intervals along the street conveyed the cheerful information that "air raid shelter" could be found in some adjoining basement or subway station. The first sight that met my eyes when I looked from the hotel window on the following morning was an immense captive balloon, suggestive of the constant patrol of the air that had been maintained since air raids on defenseless cities first were instituted by the enemy.

London was also cold, partly because of a shortage of coal and partly because the central heating plant for large buildings is almost an unknown quantity. The wasteful and inefficient open fire-place still holds sway in hotels and office buildings. Poor enough in ordinary times when there is plenty of coal, this system becomes intolerable when fuel is strictly rationed. The experience should bring home to England the necessity for burning her fuel more economically and at the same time getting some satisfaction out of it.

It cannot be said that London was hungry, but food was strictly rationed. There was enough to eat and the food was good. It lacked variety and "frills." Fruit was scarce and expensive. Sugar was issued only on delivery of the proper coupon, and we carried a week's supply of lump sugar in our pockets. Meat also was served only on presentation of the ration card, from which the waiter clipped the necessary coupons, and if the week's allotment were used at one meal, no more was to be had the balance of the week. On every hand was the evidence that London's sole business and concern was the war and its successful conclusion. These were the conditions under which the city had pursued its war vocations for four long years, never doubting the ultimate triumph and asking only time enough to train men and produce munitions. I could not help being impressed with the fact that despite the tremendous effort America was making and the vital contribution she was offering to the winning of the war, nevertheless our people had not begun to understand what sacrifice meant. Our resources were of such extent that we met the demands on our time, ability and money almost without self-denial and certainly without great sacrifice. England, on the other hand, had paid a price that we in America could not comprehend without closer contact with the British people.

The Lord Mayor's Show and Armistice Day

The day following our arrival in London was the occasion of the Lord Mayor's Show, or inaugural parade. This is an ancient ceremonial, participated in by the different guilds or associations of artisans and workmen and the representatives of the city government. A decided military aspect was lent to the parade in 1918, every branch of the British forces being represented. Allied troops also participated, and it was noticeable that the company of United States infantry received greater applause as it marched along the route than did any other unit. This demonstration, we discovered later, was a fair indication of the esteem in which America and her troops were held by England. There was the deepest appreciation of our co-operation and assistance, and an expressed feeling that the splendid relations that had grown out of the war would continue to animate the two nations in their future dealings with each other, as well as in their efforts to solve world problems.

Within three days of our arrival in London armistice was declared, an event which was jocularly referred to as additional evidence of the power of the business press of America. Either Paris, London or New York would have been wonderful places in which to observe the celebration of the armistice, but I shall always be glad that I saw it in London. The city gave itself over to the most unrestrained rejoicing. At 11 o'clock on that eventful day the explosion of the maroons announced the glad news. Within five minutes I was in the Strand, thrilled at the sight. Women, old and young,

ROAD IN FLANDERS

married and unmarried, swarmed into the street from the buildings in which they were working. With tears streaming down their faces, which at the same time were broken into smiles, they paraded, danced, sang and cheered. Not one of them but had felt the sting of war or the loss of some male member of their families, and the pent-up emotion of four long years was not to be restrained on receipt of the good news of the end of hostilities. The crowds gathered until traffic was impossible. A band of Scotch pipers appeared, followed by a long line of paraders. People rode on the hoods and fenders of the buses and taxis, and commandeered trucks and automobiles. Flags and colors appeared in such profusion that the city soon wore a holiday appearance.

A TRENCH IN FLANDERS

Business was suspended and the crowds of merrymakers owned the town. The London "bobby," wise in his day, stood aside and let the crowd have its way, well knowing that the celebration would be orderly. As a matter of fact, the only disorder of the week was the burning of some captured German artillery which was hauled to Trafalgar Square and made into a huge bonfire.

England's Reception to the Technical Press

Our first week in England might be described as reception week. The Ministry of Information had made elaborate arrangements for the business editors of the United States to meet and become acquainted with the leaders of British thought and opinion. Many of these meetings were arranged under the most delightful circumstances, such as the dinner and afternoon at the country place of the Duke of Sutherland near Guildford. Here were assembled a group of English men and women who were engaged in war work of various kinds, as members of Parliament, officers in the Army—workers in hospitals, inns for officers on leave, etc. The conversation turned to intimate phases of life and war work in the two countries and gave each an opportunity to understand better than ever before just what was in the heart and purpose of each nation and how each was trying to accomplish the desired end.

A formal luncheon by the Ministry of Information came by chance on Armistice Day, which gave a new aspect to our reception. Other luncheons and dinners followed in rapid succession: by the English-Speaking Union, the British Newspaper Conference, Sir George Perley, Lord Burnham, the National Trade Press, General Smuts and the American Chamber of Commerce in London. These were attended by eminent statesmen and representatives of industry in Great Britain, and their utterances on those occasions were reported in full in the daily press of London.

The English-Speaking Union is an organization the purpose of which is sufficiently indicated by its name. With the Rt. Hon. Arthur J. Balfour as its president, it is composed of the leading thinkers of Great Britain who are desirous of bringing about a closer relation between the English-speaking peoples of the world. At our luncheon Sir Arthur Steel-Maitland presided, and we were addressed by Mr. John Hodge, Minister of Pensions, and Major Evelyn Wrench. Others in attendance were Sir Gilbert Parker, Lord Desborough, Sir Campbell Stuart and American Consul General Skinner. Cables of congratulation were despatched by the Union that day to Marshal Foch, Field Marshal Haig, Admiral Wemyss and General Pershing.

At the dinner of the British Newspaper Conference the principal speakers were Mr. Balfour and our own Admiral Sims. The dinner by Lord Burnham, owner of the London *Telegraph*, was a brilliant function at Claridge's, attended by Winston Churchill, Sir Frederick Smith, Sir Arthur Pearson, the Lord Mayor of London and some of the other city officials, Raemakers the cartoonist and other notable people. It was on this occasion that Sir Frederick Smith told of the desperate situation in France in the spring of 1918, when plans were made to salvage whatever was possible of the British forces and supplies in France and begin preparations for a still longer war before victory should be won. At no time was there a thought of defeat, but only terrible and costly delay in the final accomplishment. The British fleet was always the strong reserve arm of the empire, and could be relied upon to protect the homeland and keep the seas open until men and supplies could again be marshalled in sufficient numbers to gain the victory. Winston Churchill spoke feelingly of America's aid in the war, characterizing our intervention as "the greatest mental effort and spiritual realization of truth which has occurred in the whole course of secular history."

Mr. Churchill on British Sea Power

Mr. Churchill spoke again at the luncheon of the National Trade Press, and paid his respects to those who deprecate British supremacy of the seas. Sea power is vital to England and her colonial possessions, he said, and could not be minimized without jeopardizing the integrity of the empire. With regard to future military and naval preparations by the nations of the world, Mr. Churchill proposed an international register of all naval, aërial and military plans, and an international commission of inspection to see that no secret preparations are made.

One of the most interesting and important functions was the dinner given by Lt. Gen. J. T. Smuts, a Boer who had fought Great Britain in South Africa in the Boer war, but who was now in the British forces and a member of the Supreme War Council of five. Gen. Smuts had cleaned up German East Africa before coming to London, and had shown his loyalty to the principles of Great Britain despite his "slight difference with

that country some years ago." In the course of a statesmanlike speech, he paid tribute to the beneficent régime which Britain has always endeavored to establish in her colonies and over conquered peoples. One could but contrast the attitude of those peoples who have been conquered by the Germans during the past four years. Admiral Jellicoe, Arnold Bennett, Lord Islington and other distinguished gentlemen attended this dinner.

Despite the appearance of a round of social pleasures which this succession of functions suggests, there was a serious purpose in all of it, and the luncheons and dinners were merely the medium chosen for its accomplishment. It was a tribute to the technical and business press of America of which we may well be proud.

St. Dunstans, a School for Blind Soldiers

During this first week we found time also to visit St. Dunstans, a school for blind soldiers; the Y. M. C. A., Eagle hut and officers' inns, and other places of interest. St. Dunstans holds unusual interest because it is making independent, self-sustaining, useful men out of blinded soldiers. The grounds and buildings were loaned for the purpose by Mr. Otto Kahn of New York, and the organization of the teaching force, etc., was arranged by Sir Arthur Pearson, himself blind for the past few years. The psychology of the institution as presented to a blinded soldier just entering may be expressed about as follows: "You are not blind and therefore helpless; you have merely lost one of your five senses, and you still have four that you know little or nothing about. They can be trained so that you can be an independent and useful member of society." A story of wonderful human interest could be written about this institution, which practically embodies the common sense of an intelligent man who knew that it was possible for a man to lose his sight and yet preserve his independence.

A Visit to the Grand Fleet

The Grand Fleet of the British Navy is a powerful agent for peace or war. In years past it has been both, no doubt, but during the last four years especially it has been the greatest silent potential force of the Allies in their struggle against German world domination. Knowing something of the majesty of this arm of the British defense, we were delighted to have an opportunity to visit the fleet. Our course lay by rail to Edinburgh, and thence by motor to Rosyth, where the fleet lay in the Firth of Forth. Fog prevented our getting a view of the entire fleet at one time, but we rode in a motor launch up and down the lines of dreadnoughts, battleships and cruisers, all lying at anchor inside the famous Forth bridge. A few battleships of the American squadron were lying just outside the bridge. We were received on board the *Orion* by Admiral Goodenough and the ship's officers, and subsequently divided into parties for dinner on several of the battleships, the party of which I was a member going to the *Monarch*, where Capt. Drury-Lowe and his staff received us most cordially. After dinner we inspected the ship from fighting-top to engine room, and observed in action the mechanism for loading and firing the big guns in the turrets. Returning to the *Orion* we were all taken to the *New Zealand*, and after a brief inspection and reception we returned to shore.

CATHEDRAL AT ARRAS

Our visit was just two days prior to the surrender of the German fleet, and the British officers were anticipating the event with mingled feelings of satisfaction and regret. They would much rather have sunk the enemy in a fair engagement, and considering their four long years of vigilant watch, one could not deny them the wish that they might have met their enemy in an open fight. I think they still hoped, and maybe suspected, that the enemy would not surrender without a show of force, but they were all ready to meet him.

The Lord Provost and Corporation of Edinburgh tendered us a dinner at the City Chambers, where we met the leading men of the city. Arrangements were made for a special visit to the famous Castle, under command of Sir Robert Moncrieffe, and to all the apartments in Holyrood Palace. These historic places held a world of interest for us and recalled forgotten incidents in English history, particularly of that ill-starred personage Mary Queen of Scots.

At Glasgow we visited the great shipbuilding works on the Clyde, particularly those of William Beardmore & Co., Ltd. This plant was devoted entirely to war work, not only in the construction of ships, but in the manufacture of big guns and shells, airplanes and airships. These side issues were undertaken without any previous experience or preparation, and the success of the work is a tribute to the management. We found some labor conditions that to us were unusual. Hours of labor, for instance, surprised us. The men go to work at 6 a.m. and work until 9, when they stop for breakfast, resuming again at 9:45. A noon hour is taken at 12:30, and work is stopped about 5:30 or

6 p.m. It was admitted that the first three hours of the day's work were very inefficient, and that a straight 8-hour day would be better. To us it seemed as though a man could not be efficient if he went to work cold and hungry, with a prospect of three hours work before eating. A luncheon given us by the staff of Beardmore's gave an opportunity to discuss a number of industrial problems and compare notes on conditions at home and abroad.

That evening we were the guests of the Lord Provost and Corporation of Glasgow at a dinner at the City Chambers, where we met not only the city officials but some of the leading educators and thinkers of the community. The speeches disclosed the Scot at his best, particularly Bailie John Muir, whose homely philosophy and keen wit received sincere applause.

Armistice Prevents Bombing of Berlin

Returning to London, we visited the Handley-Page airplane factory primarily to accept an invitation for a flight, but this was prevented by a fog. We had the pleasure, however, of climbing into and inspecting a special plane which had been built to bomb Berlin, and which was to have left on its mission on Nov. 13, two days after armistice was declared. This machine has a wing spread of 127 ft., a carrying capacity of 14 tons, four engines aggregating 1400 hp., tanks for 1500 gal. of gasoline, two pits for rapid-fire guns, one fore and the other aft, and storage for five tons of bombs. The great regret of the air forces of Great Britain was that the preparations for retaliation were not advanced swiftly enough to permit the bombing of Berlin before the war ended. It was the great regret of our party that London fog was so persistent that we were unable to make a flight in London or to carry out the plan for flying across the Channel from England to France.

A Visit to Hadfield's

Although the Ministry of Munitions promptly closed all plants to visitors when armistice was declared, it was possible to visit one or two. Unfortunately we were not allowed to enter any of the great munition plants such as Gretna. There was the most cordial and free interchange of information between England and the United States while the war was on, but the practice stopped rather abruptly with the end of hostilities. Several of our party who were interested in metallurgy went to Sheffield and visited the steel works of Sir Robert Hadfield. The plant, like others throughout the country, had been greatly increased in size for the manufacture of guns and shells. An indication of one of the problems in the machine-tool trade was found in the fact that Hadfield's alone would discard 1000 lathes for which they had no use in peace times. Women had been largely employed in the plant, working at the lathes and at lighter work around the shops. At a later visit with Sir Robert Hadfield in his London home we learned something of the work his company had done in the development of manganese steel helmets and body armor. The former were superior to those used by some of the other nations, and while the latter were effective as far as protection was concerned, they were not practically useful. We saw specimens of helmets and armor that had successfully resisted rifle fire comparable to that which would be encountered in warfare. We were also given a private view of Britain's accomplishments in the line of super-shells and guns. They were not used in actual combat, but had been built and tested, and could have been put to work if occasion had demanded.

Technical Man Awaits Appreciation in England

A too brief visit to Sheffield University allowed me an hour with Prof. J. O. Arnold, who is at the head of the department of metallurgy and engineering. It is greatly to be regretted that work such as Prof. Arnold has done and is doing is not adequately supported. It seemed to me as though England had not yet risen to an appreciation of her technical men, despite the fact that they were the ones on whom she had to call when she was confronted by a foe skilled in technology and the application of science in the art of warfare. I was told that the Government had actually contemplated providing chemists for some of its works with the munificent salary of £125, about $625, per annum, a sum which would not attract a bottle washer in our American laboratories. This was but one instance of what seemed to me to be a lack of appreciation of technical education, but I was told that a change is coming and that England is alive to the needs of research, co-ordination of industry and universities, and the value of technology in the national life. Incidentally, some excellent work has been done by such men as Prof. Arnold and Sir Robert Hadfield, and we may expect some good papers from their pens.

One of those delightful informal social events that marked our stay in England was our entertainment by Sir Thomas Lipton at his home near London. We motored out in time for dinner, spent a delightful afternoon and returned after tea. Sir Thomas, of course, is known as one of the world's greatest sportsmen. His charming Irish wit and manner, coupled with his whole-souled love of sport, make him an ideal host. He told us of his hopes, which we learned later had been blasted, for a yacht race with America in 1919, and he gave us all shamrock pins which we promised to wear when the race was run. Sir Thomas has been heart and soul in the war and has done a fine work in his support of the Red Cross. On the occasion of our visit he invited Sir Andrew Weir, Surveyor General, who has charge of the purchase of Government supplies, to meet and talk with us.

Lord Northcliffe Entertains

Before leaving England we were entertained at luncheon by Lord Northcliffe, owner of the London *Times*, at Printing House Square. For this occasion our host had invited leaders of industry and political thought to meet and talk with us, and we counted the affair one of the most instructive we had attended. Sir Robert Hadfield spoke of the possibility of giving workmen a summer holiday with pay instead of making them take their holidays on their own time. Mr. W. L. Hichens, chairman of Cammel Laird & Co., spoke of his desire to improve the condition of the worker, maintain his high wages and reduce his working hours. To do this, he said, would require more money on the part of the capitalist and more work from the worker. Both labor and capital must see that they are going to profit out of

CONDITIONS IN THE COAL MINING REGION OF LENS

the improved order of things, and the community is to be the final judge of whether they are profiting enough or too much; neither should be allowed to hold the community up for ransom. He felt that the principle that "Might is Right" is what we have been fighting against in the war just closed, and that the principle was not acceptable in industry any more than it was among nations. Other speakers at the luncheon voiced interesting views on the problems that were confronting the nations of the world; all were optimistic, but earnest in the belief that the times demand new methods and ideas.

The Battlefields of France

The English Channel is proverbially a difficult piece of water for poor sailors to cross, but we were kindly treated to a comparatively smooth sea when our party crossed from Folkestone to Boulogne. Before we were able to leave London for France we were obliged to spend several very good and precious hours getting passports properly stamped. War-time travel is beset with difficulties enough to deter any but those for whom the way is smoothed as it was for us. Other civilian travelers who had not the kindly arm of the British Government about them were subjected to much delay and annoyance trying to prove their identity and show the necessity for travel between the two countries. We were practically the only civilian passengers on the boat leaving Folkestone. Arriving at Boulogne we were met by military representatives of the Ministry of Information, who took us immediately by auto to the château at Radinghem which had been provided as headquarters for American visitors. The château is a thirteenth-century structure, with moat and drawbridge, which had been fitted with some modern conveniences. Here we were comfortably quartered for several days while we made daily automobile trips of about 150 miles to various parts of the battlefront which had been lately abandoned.

Our hosts at the château were British officers who were familiar with the military history of the ground to be covered, and each night we received a brief lecture on the points to be visited the following day. Military maps were provided on which the route could be traced and points of interest noted.

Our first day's trip took us to Bethune, La Bassée, Lille, Menin, Ypres, Poperinghe, Steenvoorde, Hazebroucke. The terrific effect of modern shell fire was evident at all of these places. Our first introduction to it was at Bethune, but it was at La Bassée that we saw it at its worst. La Bassée literally has not two bricks held together by the original mortar. Houses, store buildings and churches are piles of brickbats and rubbish. Here and there we saw great concrete gun foundations and shelters, reinforced with steel. The walls and roofs of these structures were four feet thick, and the foundations much heavier. There was a great deal of this concrete work throughout the country occupied by the German forces, and the magnitude of the work recalled the quarrel that Germany had with Holland

regarding the transportation of sand and gravel across the latter country. Germany professed at the time that the material was altogether for peaceful purposes.

Devastation in the Battle Area

The destruction of cities and towns in France is so complete along the line of battle that one place looks much like another and no powers of description can enable the reader to visualize the wreckage. Occasionally small towns have been so completely wiped out that the place on the road is marked by a sign post informing the traveler, for example, that "This is Souchez." In some of the illustrations accompanying this article I have tried to give an idea of the destruction of cities, the churning of the ground by high-explosive shells, the nature of barbed-wire entanglements and trenches, etc., which are much alike throughout the length of the battlefront.

The city of Lille was not damaged by bombardment, being held by the Germans throughout the war, but when it was evacuated the bridges were destroyed at every approach to the walled city.

We crossed the Lys into Belgium at Halluin and Menin and took the Menin road to Ypres. This was the most desolate spot I have ever seen, uninhabited and uninhabitable, filled with trenches and lines of barbed wire, pitted and scarred with shell craters that were partly filled with water. The trenches in this section, in front of Ypres, were shallow and the dugouts were filled with water. At one place we saw an abandoned contractor's

CAPTURED GERMAN GUNS IN PARIS

pump that had been used to keep a dugout reasonably free from water. It was inconceivable that men could withstand the hardships of such a life as they had to live here.

Entering Ypres by the Menin gate, we traversed a part of the city and saw the ruins of the famous Cloth Hall and the cathedral, both damaged beyond repair. Although this city was never taken by the Germans, it was shelled from three sides and was practically destroyed.

Wanton Pillage of Douai

On our second day out from the château we went to Arras, Douai, Lens, Vimy Ridge and other places of less importance. Douai roused our ire more than anything we had seen because it showed the effects of wanton destruction and pillage by the Germans. Externally Douai presents the appearance of any city outside the war zone, but within its houses, stores and churches are the evidences of vandalism, plundering and despoliation. What could not be carried away by the Germans as booty was destroyed. Oil paintings were ripped from their frames, mattresses cut open and dumped on the floor, books swept from their cases and china from the cupboards, plumbing and all metal work ripped out and taken away. We found M. Paul Robaut, general secretary for the French Red Cross in Douai, whose home had been used for a long time as headquarters for the German Red Cross. He was deported from the city last September with all other inhabitants, and when he returned he found his beautiful home in such a condition of destruction as could not have been accomplished by earthquake and cyclone. Nothing but the hands of an army of German soldiers sacked Douai and left it in its present pitiable condition. Here also in one of the houses that had been used as German billets we found a German saw-tooth bayonet, a wicked instrument. We left this place thoroughly convinced that any distinction between the German people and their rulers was quite unnecessary.

The coal-mining region of Lens also presented a scene of destruction that could be accomplished only by the hands of fiends. No one knows what may be the condition of the coal mines of Lens. It is reported that they were dynamited by the Germans before they were abandoned, and that they have since filled with water. As the mines are deep and the veins narrow, it may be impossible to recover them through the present shafts. Certain it is that all surface workings have been destroyed beyond repair and the villages of the region rendered uninhabitable. The first step toward rehabilitation will have to be shelter for the workmen.

Vimy Ridge was an impressive battlefield, for it could be seen how certain death must follow the order to cross the narrow valley and assault the ridge held by the Germans. Quantities of ammunition still were stored by the roadside in huge dumps, and there was evidence of the fiercest fighting.

On the Hindenburg Line

The third day's ride took us to Albert, Bapaume and the Hindenburg Line and Canal du Nord on the road between Bapaume and Cambrai. At one point on the limestone road we saw an impressive sign "Dust Draws Hell Fire—Go Slow." Closer examination showed that originally it had read "Shell Fire," but the erasure of the S had left the sign fully as significant and appropriate as it was originally. The sign had been placed there as a caution to truck drivers in the army trains.

We spent some time at the Hindenburg Line, examining the trenches and dugouts. The latter were quite comfortable, and the line as a whole looked almost impregnable. Tanks, however, were more than equal to this line of defense, and we saw the tracks of these monstrous engines as they had forced their way over trenches, barbed wire, shell craters and obstacles of all kinds. In tank construction and operation the Allies far excelled the Germans; the British counted them their greatest achievement in land offense.

Leaving the château and our British hosts, we went to Paris. There was a marked difference in some fundamental conditions in Paris as compared with Lon-

don. Food was more plentiful and in greater variety, although it was also more expensive. Fruit was available in better quality, but at several times the price in London. Meat could be secured without ration cards, but bread tickets were necessary if one cared for bread regularly. Paris was warm, too, and this in spite of the fact that coal was scarcer than in England. This was due largely to the fact that there are central heating plants in the hotels and large buildings, insuring more efficient combustion of the fuel.

The President in Paris

We were in Paris when President Wilson arrived, and witnessed the genuine and sincere demonstration which greeted him. The English and French people were deeply interested in his coming, and we repeatedly heard expressions of astonishment at the opposition to his trip which developed in America. To them Mr. Wilson embodies our great nation and the vital assistance which we rendered at a critical moment, and it seemed to them most logical that as the head of our nation he should participate in the negotiations for peace. Furthermore his idealism appeals to the French; and in England also we heard many expressions of approval of the ideas and ideals he has advanced. His arrival in Paris was the signal for a demonstration which lasted far into the night. There were parades with banners bearing the inscription "Vive la Paix Wilson," and many other demonstrations of approval of the President of the American republic.

Only one industrial plant was open to us in France, that of Andre Citroën in Paris. This is a modern munition plant for making the French 75-mm. shells. It is equipped with American machine tools and laid out on modern lines. Considerable attention is paid to the welfare and working conditions of the employees, of whom there were 12,000. Women were employed to the number of 8000. There was a dining room seating 3500, and rest rooms where employees could take recreation during the day. Complete laboratories for chemistry, metallography and physical testing were an important part of this modern plant. Women were employed in the laboratories, holding assistant positions. Men's wages were $5 to $6 per day, and women's $3 to $4, being about twice the wages of four or five years ago.

A trip to Versailles gave us an opportunity to visit the Palace, and see the Galerie des Glaces, in which the final sessions of the Peace Conference are to be held. It was in this room that the great German Empire was formed years ago, and here it will receive its finishing touches at the hands of the Allies. En route to Versailles we stopped at the Hôtel des Invalides, where the war museum was opened to our inspection, and special permission was granted to visit the tomb of Napoleon. The latter was still encased in the sandbags that had been placed around it as protection from aërial bombs.

Champagne Cellars at Rheims

Further visits to the battlefield were made from Paris under the escort of French officers representing the French High Commission. Noyon, Rheims and Berry au Bac were thus visited. Each had its special interest which cannot be described at length here. At Rheims there was the famous cathedral, still beautiful in its ruins. We were informed that it can be restored, and we presume it will be in due time. The Pommery champagne cellars at Rheims were also an object of satisfied curiosity. These cellars are but part of great limestone workings that underlie the entire city, extending for an aggregate distance of 60 miles. The Pommery cellars alone are 12 miles in extent. French troops were quartered in these cellars during the war, and moved from one part of the city to another without observation. We were told that Pommery cellars contained 8,000,000 bottles of champagne and that 60,000,000 was the total number in the cellars of the city.

The battlefield of Berry au Bac was notable for the fighting about Hill 108, and for the engagement of 80 tanks in a French assault on the German line of trenches. The assault was successful in that the trenches were taken, but when the tanks proceeded beyond the line and exposed themselves to direct gun fire in the open, they met with disaster and only 40 escaped destruction. Forty great hulks were still on the field when we were there, helpless looking machines when disabled by heavy gun fire, although very effective in assaulting infantry lines.

The King of Saxony's Dugout

The dugouts at Berry au Bac were the most elaborate in extent and equipment of all that we saw. They formed a continuous line of communication thirty feet beneath the trenches for a distance of about two miles. In one of them, reputed to be the underground dwelling of the King of Saxony during his occupation of that part of the line, we found a fine brick mantel and fireplace, desk, chairs, mirror, bed and evidences of telephone and electric light connections. Our conductor on this occasion, Lieut. Verdier, had fought at this point and was able to give us a very interesting account of the engagement.

For a few days we were in the hands of American officers at the visitors' quarters at Neufchâteau, and from this point made a one-day trip by auto, about 160 miles, into the city of Metz. The principal items of interest were the overturned monuments of the German Emperors, the supercilious statue of the late Kaiser among the prophets on the great cathedral at Metz, and the external evidences of damage that had been wrought on the property of German sympathizers. Store signs were being changed from German to French, and there was every evidence that it would be both popular and profitable to be French or at least a French sympathizer.

France's Disabled Industries

France gives one the impression of being somewhat dazed over her recent experience, and at a loss to know just where to begin to retrieve her lost fortunes. We had a number of dinners and luncheons with their leaders of industry, who said frankly that France was in the position of having to ask preferential treatment at the hands of the other nations. One gentleman even suggested that they would like to see French goods enter the United States duty-free, and American goods pay a duty on entering France. They are alarmed at the prospect of the Germans capturing world markets before France can even rehabilitate her factories and get new machinery in running order. The Germans return

to factories that are intact, ready to turn out their products into world trade, while France must begin at the bottom and build again her principal industries. These are the things that worry France and are probably having something to do with the new terms in the extension of the armistice period.

Returning to England from France, we spent a few days in London, during which time we were entertained at tea in Stationers Hall by the Circle of Scientific, Technical and Trade Editors. This is an organization that is striving to raise the standard of editorial work and the status of the editor in England. An exchange of views for an hour or more was profitable to all of us.

The Ministry of Information gave us a farewell luncheon in London on Dec. 19, and on Dec. 22 we sailed from Liverpool on the S. S. *Carmania*. The return voyage was made without the precautions that attended our trip eastward, although life-jackets were still recommended and a boat drill was held. Our ship carried mine sweepers on either side near the bow. We were carrying about 3000 Canadian troops bound for Halifax, and on reaching that port we secured shore leave so that we might see the results of the terrific explosion in the harbor in December, 1917. We also had an opportunity to inspect the new $35,000,000 water and railroad terminal which the Government is constructing. The balance of trip down to New York was uneventful, and we landed on New Year's Day, glad that our home is in the U. S. A., but not forgetting the ties that must inevitably bind us closer to our English-speaking friends on the other side. One cannot experience two months of travel in foreign lands and contact with peoples with whom we have been united in a vital struggle without getting a new point of view, broader, larger, more comprehensive and sympathetic. We have been deeply impressed with the endurance and fortitude of the British and French, and we can but admire the high ideals that animate them in their approach to the solution of problems that concern the world's future welfare. Our own participation has been deeply appreciated, so much so that we are likely to be led into exaggeration of the importance of our part in the great struggle. At the same time our help is just as urgently sought in meeting the problems of peace, and to that end we must all lend sympathetic and broadminded aid.

Two Great Problems

There are two great problems in which we are interested: The reconstruction of French and Belgian industries, and the reparation by Germany for the destruction of life and property. Reconstruction will come slowly because there are human problems of shelter and sustenance to be solved before factories and shops and works are rebuilt. Some cities may not be rehabilitated; new sites will be chosen after due study by a central organization in Paris. Reparation, of course, must be made by Germany to the fullest extent. The German nation today is an unrepentant and unchastened people, but perhaps the size of the bill to be paid may awaken them to the enormity of their crimes against civilization. There is no need for leniency or magnanimity in itemizing the bill or exacting its full payment. The Germans are resourceful and frugal. They have learned the lesson of self-denial and saving, and they can continue in these habits and apply the product to the expiation of their crimes.

The bill will be large, but time can be allowed for its payment in full.

Synopsis of Recent Chemical and Metallurgical Literature

Die Casting of Aluminium Bronze.—H. RIX and H. WHITAKER of the British Westinghouse Co. read a paper on the above title before the March, 1918, meeting of the Institute of Metals. They point out the advantages of die castings as follows: Die castings are uniform and accurate to 0.005 in. or less; they eliminate machining and they allow a high, continuous output. The cost of the casting should be analyzed, adding the proportional cost of the die, which is apt to be very large, in making a comparison to the sand casting, where machining must be added. Die castings were made more than twenty years ago of low-melting white metals. The many advantages of aluminium have been nullified by its high melting point; by the fact that it attacks iron when hot, thus reducing the life of the dies to as low as two thousand casts; by its weakness when hot and by its high shrinkage. The latter has been reduced to 1.4 per cent by proper alloying.

Successful castings in quantity are made by the authors using bronzes containing from 7 to 10 per cent aluminium and 1 to 4 per cent iron. The effect of the iron is important. Some iron and aluminium enter into solid solution with the copper, forming the alpha-constituent, but the bulk of it probably separates out as a high-melting point compound like $FeAl_3$, which forms a skeleton in which the residual metal solidifies. This refractory skeleton thus reduces the shrinkage and produces a fine grain. The iron also increases the yield point and ultimate strength at the expense of ductility. The properties of the finished casting vary with the heat treatment, the speed of cooling, the temperature of the metal, of the mold, and of stripping. Fortunately the above alloys show no beta-constituent; therefore it is not so responsive to heat treatment as though this metal were present. The alloy cast in a 1-in. chill gives the following tests:

Diameter of test section, in.	0.564
Yield point, lb. per sq.in.	29,400
Ultimate tensile strength, lb.	71,000
Elongation in 2 in., per cent	24
Reduction of area, per cent	21.8

For a scientific investigation into die casting, the authors point out the following points for study in the alloy to be used: Its coefficient of expansion at different temperatures, fluid and solid; its specific heat; its thermal conductivity; its mechanical properties at high temperatures; its mass, volume and surface area when cast; its latent heat of fusion; its metallography; its pressure on the die, and its fluidity.

The discussion of the paper brought out the fact that the iron should be added to the alloy as pure wrought iron chips, silicon in the addition being fatal. The metal should be melted at as low a temperature as possible and properly killed, the melting practice being responsible for many blowholes and other defects. The cores should be removed at the right time so that by shrinkage the solidifying metal about them might not rupture through setting up internal strains. In some cases the handling of cores was so difficult that openings could be more cheaply machined. Bottom gating gives a flow of metal which has a cleaning effect on the molds, but which requires more gates, vents and risers. Aluminium in alloys seems to protect the cast iron dies by the formation of a skin of alumina; this is quite an advantage over brass, as the latter forms a zinc oxide coating which must be carefully cleaned out between casts. Success in die casting involves starting with relatively simple forms, and then the expenditure of much capital, patience and brains in working to more complicated castings.

The approved material for dies is a chill-cast block of close-grained, gray cast iron, as hard as can be machined. Two analyses quoted were:

	Per Cent	Per Cent
Combined carbon	0.14	0.84
Graphitic carbon	3.35	2.76
Silicon	2.40	2.02
Manganese	0.43	0.29
Sulphur	0.10	0.07
Phosphorus	1.3	0.89

The latter is perhaps a little high in combined carbon, as this element causes growth and deformation in the hot die. The former is also too high in phosphorus. A well made die with these specifications will stand from five to seven thousand casts with the aluminium bronze under discussion, and then fail by the development of small cracks at right angles to the axis of the piece, especially where there is the largest heat transfer. No facing is required, the fine particles of graphite in the metal effectually acting as a lubricant. This graphitic sponge also allows the ferrite matrix to expand more readily and with less internal stress than would be the case in a close grained block of steel or nickel. No special cooling of such dies is required. Each casting is matter of individual study—for that matter, different alloys may not be cast successfully in the same die, owing to their different requirements in shrinkage, gating, etc. About the only advice which can be given as to the design of dies is that the mass of the metal should be such that the rate of cooling of the contained liquid metal should be at the same rate in all parts. The core-plugs are made of chrome-tungsten steel, and are dipped in graphite wash after they are withdrawn, but even so they last only from one-half to one-third as long as the die.

Evaporation of Small Spheres.—IRVING LANGMUIR (*Physical Review*, Vol. 12, p. 368) assumes that evaporation of small objects in air should be closely related to the convection of heat from bodies of the same shape. Previous researches on the latter (ibid., series I, vol. 34, p. 401) had shown him that the loss of heat from small wires consists essentially of conduction through a film of relatively stationary gas around the wire. Thus he believes that the air in contact with small evaporating spheres (of iodine, for instance) is saturated, that the exchange of molecules between the solid and its surrounding vapor is very rapid compared with the rate at which the vapor can diffuse away through the air and that no allowance need be made for air currents. On this basis a formula is developed which shows that the rate of evaporation is proportional to the radius of the sphere—as previously determined experimentally by H. W. Morse—and from which, using Morse's results, the diffusion coefficient of iodine vapor in air at 20 deg. C. is calculated to be 0.053, a figure in harmony with known coefficients for vapors of high molecular weights.

Convention of National Foreign Trade Council

The National Foreign Trade Council will hold its sixth national foreign trade convention at the Congress Hotel, Chicago, on Thursday, Friday and Saturday, April 24, 25 and 26, 1919. The formal call will be issued shortly by the chairman of the council, Mr. James A. Farrell, president of the United States Steel Corporation. The convention will deal with foreign trade as a factor in stabilizing American industry—problems involving the conversion of war industries to the needs of peace; development of our foreign trade to provide employment for our soldiers, sailors, and war workers; and the formation of a definite policy dealing with the future of our new shipping.

Imports and Exports of Gold and Silver

The Bureau of Foreign and Domestic Commerce reports that imports as well as exports of gold continued to decrease during the latter part of 1918, the imports amounting to $62,000,000 in the calendar year, against $552,000,000 in 1917, and the exports to $41,000,000, against $372,000,000. Imports of silver increased from $53,000,000 in 1917 to $71,000,000 in 1918. The exports of silver during December, 1918, amounted to $48,000,000, a larger amount than in any month during the past three years. For the calendar year 1918, exports of silver amounted to $253,000,000, against $84,000,000 in 1917.

Employees of Copper Companies to Meet Secretary of Labor

The Secretary of Labor invited the grievance committee of employees of all the copper companies operating in Arizona and representatives of labor in Utah and Montana to send delegates to confer with him in Washington on Jan. 31 regarding labor conditions in the copper districts. The copper industry is confronted with grave conditions owing to the reduction of output and employment, and it is the purpose of the Department of Labor to cooperate in securing the best working conditions during the period of readjustment.

Meeting of the Canadian Mining Institute

The Canadian Mining Institute will hold its twenty-first annual meeting at Montreal, Canada, March 5 to 7. A special invitation has been extended to the members of the American Institute of Mining Engineers to attend and participate in this meeting. March 6 will be American Institute of Mining Engineers day. As at the New York meeting of the A. I. M. E. in February, there will be a discussion on international co-operation in mining and uniform mining law for North America at the C. M. I. in March.

Book Reviews

THE ZINC INDUSTRY, By *Ernest A. Smith*, Assoc. R. S. M. 211 pages, illus. Price $3.50. New York: Longmans, Green & Co.

This is one of the excellent "Monographs on Industrial Chemistry" edited by Sir Edward Thorpe, designed to give the average reader a clear view of certain important manufacturing processes as influenced by chemical phenomena. Therefore, while this particular book does not attempt to present the details of mining, metallurgy and selling, more ambitious writers could do well to present their material in a manner as clear and inclusive. For instance, it contains well selected and easily understood data on the metallography of pure zinc and its common alloys, even including the more modern zinc-base die casting compositions. In view of the economic and commercial aspect of the metal, the author is necessarily influenced by his British citizenship; a foreshortened view of the technology is fortunately easy to avoid. In the chapter "The Rise and Progress of the Production" is an instance of the oft-recurring cycle of events. One notes the fact that the manufacture of brass from liquid zinc was long neglected for the ancient process of cementation by calamine, until finally the Prussian industry in 1825 (pointing the way for the American Zinc Institute) offered prizes for the discovery of new uses for zinc metal. American producers would also profit from the pre-war decadent condition of the British spelter industry as compared with that on the Continent, due, as the author states, to neglect of modern progress in plant design, to a lack of scientific control of the process, to the absence of co-operation among producers, and to the failure to build and maintain an adequate supply of skilled workmen.

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BIBLIOGRAPHY OF FOREIGN TRADE PUBLICATIONS. By *Herbert Stanley Shuey*. 78 pages. Price $1.50. San Francisco: The ten Bosch Co.

This compilation of references on foreign trade will be a distinct aid to those business houses, banks, manufacturers and others who expect to participate in export business. The author, who is lecturer in commerce at the University of California, has gathered together only those sources which are recognized as authoritative, including publications of the Bureau of Foreign and Domestic Commerce and other Government papers. References are grouped under appropriate heads such as commercial policies and tariffs, directories, export journals, financing, foreign markets, geography and commerce, insurance, statistics, theory and international trade, transportation and trade routes and year books.

Personal

CAPTAIN EDWARD E. ASHLEY, JR., formerly consulting mechanical and electrical engineer for Starrett & Van Vleck, New York City, has resigned his commission in the Air Service of the U. S. Army, to accept the appointment as sales engineer of the Mercury Mfg. Co., Chicago, Ill.

DR. D. D. BEROLZHEIMER, librarian of the American Chemical Society, 1910 and 1911, librarian of the Chemists' Club, 1910 to 1915, and librarian of The Barrett Co., New York, since April, 1915, has severed his connection with the latter firm and is now assistant technical editor with the Chemical Catalog Co., 1 Madison Ave., New York City.

BRADLEY, BRUFF & LABARTHE have been retained by the Penarroya Mining & Metallurgical Co. of Paris to design a complete lead smelting and refining plant to be erected at Penarroya, Spain.

MAJOR F. E. BREITHUT, Chemical Warfare Service, has been detailed by the War Department to the War Trade Board to act as chairman of the chemical group of the price section. This group is engaged in a study of price fluctuation of chemicals during the war and an analysis of its cause and consequence. Associated with Major Breithut are Mr. F. W. Cassebeer, Capt. P. W. Carleton, Lieut. Chas. L. Fry, Lieut. W. N. Jones, Mr. H. L. Lewenberg, Capt. W. Lee Lewis, Mr. W. B. Meldrum, and Capt. H. L. Trumbull.

CAPT. DECOURCY BROWNE, Ordnance Department, U. S. A., expects to return to the United States from France in the near future and will be located at the Engineers' Club, 32

W. 40th Street, New York. Captain Browne, before entering the service, was metallurgical engineer of the Metal & Thermit Corporation, New York.

COL. G. A. BURRELL, recently of the Chemical Warfare Service, has opened an office as consulting chemical engineer in Pittsburgh, Pa.

MR. C. W. CROMWELL of the engineering firm of A. G. McGregor, Warren, Ariz., is in New York City.

MR CLARENCE T. EMRICH resigned his position as chief chemist with the Old Dominion Co. to accept the position of assistant superintendent with the International Smelting Co. at Miami, Ariz.

MAJOR A. C. FIELDNER, Chemical Warfare Service, U. S. A., who was in charge of the gas mask research at the American University Experiment Station, Washington, D. C., has returned to the Pittsburgh station of the Bureau of Mines, where he will have charge of the chemical research laboratory.

MR. FRANCIS N. FLYNN, manager of the Consolidated Mining and Smelting Co., Trail, B. C., has resigned to become assistant general superintendent of the Balbach Smelting and Refining Co., Newark, N. J.

MR. DANIEL GUGGENHEIM has been succeeded as president of the American Smelting & Refining Co. and the American Smelters Securities Co. by his brother, Simon Guggenheim, formerly U. S. Senator from Colorado. Messrs. Murry Guggenheim and S. R. Guggenheim also retire from the active management of the companies.

MR. F. H. HAWKINS, who for several years past has held the position of chief assayer for the Standard-Silver Lead Mining Co. of Silverton, B. C., has gone to Anyox, B. C., to accept an appointment with the Granby Consolidated Mining & Smelting Co. MR. THOMAS BROWN will succeed him at the Silverton assay office.

MR. A. A. HELLER, treasurer and general manager of the International Oxygen Co., has given up his active managerial duties. MR. EUGENE SCHOEN has been appointed general manager for the company. Mr. Heller, as treasurer, continues in charge of the financial departments of the business.

MR. FRANK J. HERMAN, formerly with W. J. Rainey and more recently manager of the coke section of the United States Fuel Administration, has resigned to accept a position as assistant to the president of the Rainey-Wood Coke Co., which is building a by-product coke plant at Swedeland, Pa.

ARTHUR D. LITTLE, INC., announces the following additions to its technical staff: MR. ROBERT WOODS VAN KIRK, M. I. T. 1918, chemical engineer; recently engaged in the development division of the C. W. S., stationed at Cleveland, Ohio. MR. JOHN STEVENS, M. I. T. 1918, chemical engineering administration; recently served as a private in the research division of the C. W. S., engaged upon gas defense work, stationed first at Washington and later in the Little laboratories. LIEUT. EARL PLACE STEVENSON, Wesleyan College, Middletown, Conn., 1916, B. S.; instructor in organic chemistry at M. I. T. 1917 and 1918; recently engaged in the research division, C. W. S., Washington and Boston. MR. ERIC R. JETTE, Franklin and Marshall, Lancaster, Pa., 1918, B. S.; engaged as a civilian in the pyrotechnic section of the research division, C. W. S., Washington. In addition, the following members of the staff who had left the company's employ for governmental activities have returned to the staff: MR. HARRISON E. HOWE, consulting chemist, Ordnance Department at large, assigned to the nitrate division, Army Ordnance, for the purpose of correlating the research being conducted in various laboratories on the fixation of atmosphere nitrogen, with which division appointment is still held. He is also commissioned Major, Ordnance Section, Officers Reserve Corps. LIEUT. ROY C. CHARRON, who was first chemist for the division gas officer at Camp Devens, Mass., and later assistant to chief of the emergency laboratory section, polytechnic division, C. W. S., American University, Washington, D. C. MR. J. M. CULLEN, who was in the U. S. Navy.

MAJOR GEORGE L. NORRIS, engaged in aircraft production, has received his honorable discharge from the Army and has returned to his former position as metallurgical engineer with the American Vanadium Co., Pittsburgh. Major Norris was district manager of production, Pittsburgh office, until Nov. 1, when he was transferred to Washington and assigned to duty as chief metallurgist, raw materials department, Bureau of Aircraft Production.

MR. M. G. SPENCER, formerly connected with the Midvale Steel Co. and later with the Watertown Arsenal, in the capacity of chief chemist, has joined the staff of the Electric Steel Co. of Indiana, Indianapolis, Ind., in charge of metallurgical operation.

MR. E. E. THUM, Western editor of CHEMICAL & METALLURGICAL ENGINEERING, addressed the Utah Section of the A. I. M. E. Jan. 24, the subject being "Economic Situation of Certain War Minerals." Mr. Thum has also been asked to talk on the Nebraska potash industry before the Utah Society of Engineers, which is holding a symposium on potash on Feb. 19.

MR. JOHN T. WARD, who has been with the National Carbon Co., Inc., as chemical engineer at the Cleveland works, has been transferred to the New York office of the company as assistant to the works manager.

MR. A. P. WATT, consulting engineer, of New York, has opened an office in Boston, where he will continue to specialize on ore concentration.

MR. HENRY WIGGLESWORTH, of the National Aniline & Chemical Co., will take a leave of absence to serve for a time as a trade commissioner for the Bureau of Foreign and Domestic Commerce to study the dyestuff and textile conditions in France.

Obituary

MR. FRANK BAIRD, a graduate of the University of California, died recently at his home in Westwood Park, near San Francisco, following a brief illness from influenza and pneumonia. Mr. Baird was associated with his brother, Dudley Baird, in the Pacific Foundry Co., San Francisco. He is survived by his wife, to whom he was married last September, and by two brothers.

LIEUT. CHARLES F. HAWKINS died at the home of his parents on Dec. 27, 1918, of pneumonia following influenza. In August, 1917, he accepted a position as professor of chemistry at Williams College, resigning in February, 1918, to enlist with the Chemical Warfare Service. He was mustered out of the service Dec. 21 and returned to his home Dec. 23.

MR. ERNEST H. SIMONDS, metallurgical engineer, died at Oakland, Calif., Dec. 26, of influenza. Mr. Simonds was a graduate of the University of California and for a long time was instructor of assaying at that institution. Many of the California graduates will hear of his death with keen regret. After leaving the University of California, Mr. Simonds opened an assay office in San Francisco. The business was successfully established and was continued until the San Francisco earthquake and fire wiped it out. Simonds went next into metallurgical engineering, and established himself in a good practice.

Current Market Reports

The Non-Ferrous Metal Market

Saturday, Jan. 25.—The non-ferrous market is still lagging, while producers are reluctant to make sharp reductions enough to stimulate buying.

Aluminium:—The Government prices on ingots 98 to 99 per cent Al are $660 a ton f.o.b. plant in 50-ton lots; $662 down to 15-ton lots; and $666 down to 1-ton lots, which prices will continue until the first of March. Prices per pound for small lots vary from 40c. to 45c.; sheet aluminium, 18 ga. and heavier, 42c.; powdered aluminium, 100 mesh, 70c.

Antimony:—Wholesale lots of antimony are being offered at 7½c. while small lots bring from 7⅝c. to 7¾c. per lb.

Copper:—Prime lake is nominal at 23c. Electrolytic is selling at 20½c. and casting at 19c. The producers are determined to hold their prices high believing that the foreign demand will soon be strong.

Copper sheets, hot rolled	lb.	$0.29 —	$0.33
Copper sheets, cold rolled	lb.	.30 —	.34
Copper bottoms	lb.	.37 —	.41
Copper rods	lb.	.25½	..
Copper wire	lb.	.23	..
High brass wire	lb.	.24½ —	.26½
High brass sheets	lb.	.24½ —	.26½
High brass rods	lb.	.23½ —	.25½
Low brass wire	lb.	.26½ —	.28½
Low brass sheets	lb.	.26½ —	.28½
Low brass rods	lb.	.27½ —	.29½
Brazed brass tubing	lb.	.35½ —	.37½
Brazed bronze tubing	lb.	.40½ —	.42½
Seamless copper tubing	lb.	.35 —	.37
Seamless bronze tubing	lb.	.40½	.40½
Seamless brass tubing	lb.	.34 —	.36
Bronze (gold) powder	lb.	1.00 —	1.75

Lead:—Great interest is evidenced in the action to be taken by the Senate on cancellation of war contracts, among which lead occupies a conspicuous place. Spot New York is quoted at 5.45c. to 5.5c. per lb. and St. Louis at 5c. to 5.2c.

Tin:—The U. S. Steel Products Co. has liquidated 3000 tons of the original 10,000-ton stock at the 72c. basis. It is expected that it will take several months to dispose of the remaining stock, after which prices will fall sharply.

Zinc:—Spelter continues its gradual decline, with spot New York at $144 to $145 per ton; East St. Louis, spot $138, Jan. $137, Feb. $136, March $135 and April $134.

OTHER METALS

Bismuth	lb.	$3.50 —	$3.65
Cadmium	lb.	1.50 —	
Cobalt	lb.	2.50 —	3.50
Magnesium	lb.	1.75 —	2.10
Mercury	75 lb.	105.00 —	
Mercury	lb.	1.95 —	
Nickel	lb.	.40 —	.45
Tungsten	lb.	34.00 —	
Iridium	oz.	175.00 —	
Palladium	oz.	135.00 —	
Platinum	oz.	105.00 —	108.00
Silver	oz.	1.01½—	

The Iron and Steel Market

The rate of production on both pig iron and steel continues to decline, being in steel ingots and castings perhaps 60 per cent of capacity at the close of January, as against 80 per cent at the beginning of the month, and about 90 per cent during each of the last four months of 1918. The rate may easily, from present indications, fall below 50 per cent before the end of February. Pig iron production has not declined as much as steel production, and for this divergence various reasons may be assigned. There is a fair consumption of pig iron by foundries, and indeed some foundries, whose operation was greatly curtailed during the war, are more active. Steel works are under contract for pig iron and not for scrap, and on that account may be using a higher percentage of pig iron and a lower percentage of scrap, although the cheaper production would be by using more scrap, as scrap has declined greatly in price and pig iron is down only $3.

From a general survey of the situation the astonishing thing is not that steel production is so light, but that it is so heavy. There appears to be scarcely any demand for steel, and yet a 50 per cent operation of the present capacity means 1,500,000 gross tons per month of finished rolled steel. The Fleet Corporation is mentioned as the largest steel consumer, but during its period of greatest pressure for steel it was calling for only about 250,000 gross tons a month, and it then accumulated a surplus which it now desires to reduce. Next, the automobile industry is spoken of as a good customer of the steel industry, but it would do well to consume 100,000 tons of steel a month. As to the railroads, they are taking scarcely any rails or structural steel, but there is a very fair rate of locomotive production, and about 75,000 freight cars of the 100,000 ordered by the Railroad Administration last April are still to be delivered and the manufacture of those cars is proceeding at a good rate.

Roughly speaking, about one-third of the present steel production is against new orders booked from week to week and about two-thirds is against old orders, which, of course, are gradually playing out. The new orders are increasing slowly, not as rapidly in point of tonnage as old orders are completed, and thus the trend in production is downward. A distinct improvement in demand is expected with early spring and it depends upon how far the decline in production has gone by then whether the increase in new business will be sufficient to arrest the decline and produce an increase in operations.

Prices

Prices of pig iron, unfinished steel and finished steel are being held rigidly. There can hardly be any question about this, as all producers are watching the market situation very closely, and evidently with the intention of meeting price cutting if it occurs. No mill intends to permit another mill to "get away" with a "gumshoe campaign" such as have sometimes been conducted in the past in somewhat similar circumstances. The theory once entertained in many quarters that it would be possible for demand for iron and steel to revive with the present price level maintained is now almost everywhere abandoned. Views of the general economic situation from all angles are that there must be a general reconstitution of commodity and labor values. Commodity prices cannot stay up because labor costs are high, and labor costs cannot stay up because commodity prices are high. They did not help keep each other down during the war, and they are powerless to keep each other up in future. New construction and development are essential to industrial activity and prosperity, and the new things to be created could not compete with those in existence. While the cost of both commodities and labor has greatly increased, the intrinsic value of the material wealth of the country has not been similarly marked up, and in the long run it will exercise an important controlling influence. In the iron and steel industry proper there is no prospect that wage rates will experience any great decline in the near future, not for six months or more, but there will be an increase in labor performance, whereby labor cost will be reduced. In the activities that normally are the great steel consumers, particularly building and construction work of all sorts, a great decrease in labor costs is to be expected, through better labor performance, through the disappearance of premium rates and bonuses, and perhaps through some declines in actual wage rates.

Steel Contracts

After giving more or less favorable consideration to the new form of steel sales contract for several weeks, the directors of the American Iron & Steel Institute voted on Jan. 24 not to recommend any contract for adoption by the steel mills, and to discharge the contract committee that had been in existence for several years. The proposed contract form was drawn up with the object of making contracts binding in the finished steel trade and eliminating the practice of considering them options given by the producer to the buyer. Its important features was two paragraphs providing for the payment of "liquidated damages" by the mill if it failed to ship on time or by the buyer if he failed to specify on time. The object, of course, was not to make it that there would be large payments of this sort, but to make it that contract engagements would be so made that they could be lived up to. Those who advocated the new contract pointed out how "unbusinesslike" is the customary method of doing business, and how different it is from practices in other industries. Apparently they did not attach much importance to the fact that under the practices complained of the steel industry has been very successful, with practically no failures and with good profits except in periods of depression when such contracts did not exist.

The Next Active Period

The belief continues that there is in store for the iron and steel industry a period of several years of great activity and prosperity, the chief question being when that period will begin. There can, of course, be a full demand for the tonnage of steel that can now be made, 40 per cent greater than the capacity existing in 1914, only when there is great activity in new construction of all sorts. Construction costs must come down and the prospective investor must otherwise be assured that his investment will prove profit-

able. The only thing clear is that such a condition does not exist at present. It seems fair to assume that the peace settlement must be completed, the menace of bolshevism removed and the future status of the railroads determined.

Chemical Market

COAL TAR PRODUCTS:—Many of the operators in coal tar products regard the period of uncertainty now prevailing but temporary, although predictions vary when business will again open up and there are those who are not disposed to take an aggressive stand one way or the other. On the other hand, however, it is generally conceded that the coal tar industry has developed to such enormous proportions that the growth will result in a reduction of cost in production, which will mean lower prices to the consumer, therefore bringing about a more favorable market for American products under the heading and it appears to be the consensus that prospects for the near future are bright. In the meantime the general tone of the market is quiet, with most of the crude products but phenol and toluol holding firm in price, although the latter item has maintained a more steady position in the market at the recent decline.

Xylol: — The result of the Government's release of this item has been felt in the market, the spot situation being much easier, while the consuming demand is fairly steady and prices are firmly maintained.

Aniline Oil: — Most producers have now reduced their prices to the level of other manufacturers of this product, but there continues to be a lack of interest generally displayed about the market, with trading in small lots being the only movement noted.

Paranitraniline: — The lack of demand combined with keener competition has brought about a lower market for this product, offerings of which attract no important buying interest, despite the price concessions generally made, particularly by weak holders in the resale market.

Paraphenylenediamine: — The item is one of the coal tar products that has maintained a rather firm position in the market and most factors in this line report a fair volume of business passing. Quotations in the general market would indicate no important price changes.

H Acid: — Available supplies of this product are more than sufficient to meet the current call and a decline in price has been general throughout the market.

Sulphanilic Acid: — Many users of this material have their own facilities for production. However, beyond this situation there has been no pressing demand on the part of consumers, but on the contrary, trading has been very quiet and prices in most instances were subject to a decline.

Mixed Toluidine: — This market remains without special feature. Quiet trading is generally in evidence and prices have also been reduced 10c. to 15c.

Naphthaline: — A fair resumption of buying interest has taken place for this product and the market remains steady with prices quotably unchanged.

Phenol: — There has been no indication of any return to more normal trading for this crude, which is subject to a very unsettled position, with resale offerings being made in liberal quantities at such prices that the actual producers, who are striving to maintain at least a fair market, are apparently unable to create any buying interest.

Benzol: — There is a fair volume of business passing for this product, but trading is not in such important quantities to effect stocks on hand, which are available in liberal lots. Material in tank cars and the prices asked for that in drums remain at the previous levels.

Metaphenylenediamine: — While offerings of this material on the spot are none too liberal, there is little demand on the part of consumers and no difficulty is experienced in meeting the current call. The recent price concessions have seemingly originated no important interest on the part of buyers.

Orthotoluidine: — The item was sharply reduced in price, due to keener competition and the lack of demand, but prices apparently do not figure, from a buyer's viewpoint, as consumers have not changed from their disposition in buying only for their immediate needs.

HEAVY CHEMICALS:—There has been a continued lack of buying interest in most all the items under this heading. The marine strike, which did not reach a climax, it was feared would be a considerable handicap, but the trouble had a sudden end and the favorable reaction anticipated has not developed in any important volume, although export trading has shown signs of life. Declines in prices have been quite evident but not general, and it is unlikely that there will be any continuation of downward prices to the levels of pre-war trading. The spot market is seemingly controlled by second hands, with the actual producers not disposed to meet these lower prices. They claim that, up to the present, conditions have not been such to compel meeting this competition, the result being producers' figures are generally the outside.

Soda Ash: — A weak and unsettled market is quite evident for this material, with single bags sold during the week as low as $1.40 per hundred pounds. Bags from the warehouse were available at this figure up to the close with prices on a parity in Philadelphia, and in Chicago $1.65 was asked. Barrels ex-warehouse were quoted at $1.85 per hundred pounds, while double bags in the Middle West were held at $2.15 to $2.25 per hundred pounds.

Caustic Soda: — A more favorable inquiry was noted for the 76 per cent solid, but trading has not been in any appreciable quantities and sales were consummated at 3c. ex-store-New York and $3.20 to $3.25 f.a.s. The undertone of the market, however, appeared to be steadier and resale lots were quoted at from $3.15 to $3.20 per hundred pounds, ex-warehouse and $3.25 to $3.35 f.a.s. Producers generally quote future shipments at 3¼c. per pound, basis 60 per cent. Ground caustic is generally quoted at $4.10 to $4.35 per hundred pounds, but sales are only in occasional small lots.

Bleaching Powder: — Export drum material appears to have been the only item that was subject to any important call, with sales passing at 3c. f.a.s. The product in domestic drums was subject to no particular call and offerings from the warehouse were made at $1.90 per hundred pounds, while export drums at Niagara were quoted at 2½c.

Copper Sulphate: — A rather brisk business for export purposes, particularly to north Europe and Greece, is passing, while local trading is rather quiet. Standard 99 per cent plus large crystals are offered at 8¼c. per pound in large quantities and small crystals, 98½ per cent test, are offered at 8½c. per pound in carload lots.

Formaldehyde: — Resale lots reached the market at prices ranging from 22c. to 22½c. per pound and sales were reported to be passing at this figure. There is no liberal supply on hand and producers offer no encouragement for the immediate future, but are offering late February shipments at 23c. per pound.

Chlorate of Potash: — Operators in this commodity experienced a fair trading for export purposes and contracts in appreciable quantities have been placed with the domestic trade. Quotations remain firm at 40c. per pound ex-store and f.a.s.

Bichromate of Potash: — Forward shipments are offered at 37c. per pound through second hands, while producers are now offering spot material at the same price, and for large orders this price can be done f.a.s.

Caustic Potash: — Sales have been consummated for 88 to 92 per cent in the resale market as low as 52c. There is a lack of demand in evidence, which has seemingly brought about a lower market for this product, despite the fact that some large manufacturers have been striving to maintain prices, and as high as 67c. is being asked. There were offerings from a western source at 58c. per pound for the 88 to 92 although as low as 55c. was quoted for large quantities.

Cream of Tartar: — The item continues to be neglected to a very noticeable extent and offerings of the product are now made at 60½c. to 61½c. in barrels and 62½c. to 63c. in kegs ex-warehouse.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET JAN. 10, 1919

Acetic anhydride	lb.	1.00	—	1.25
Acetone	lb.	.25½	—	.25¾
Acid, acetic, 28 per cent	cwt.	3.50	—	3.75
Acetic, 56 per cent	cwt.	7.00	—	7.50
Acetic, glacial, 99½ per cent, carboys	cwt.	14.50	—	15.00
Boric, crystals	lb.	.13¼	—	.15
Citric, crystals	lb.	1.25	—	1.27
Hydrochloric, C. P	lb.	Nominal		
Hydrofluoric, 30 per cent, in barrels	lb.	.08	—	.08¼
Lactic, 44 per cent	lb.	.14	—	.15
Lactic, 22 per cent	lb.	.06	—	.07
Molybdic, C. P	lb.	6.90	—	7.40
Nitric, 36 deg	lb.	Nominal		
Nitric, 42 deg	lb.	.08¼	—	.10
Oxalic, crystals	lb.	.36	—	.38
Phosphoric, 47-50 per cent paste	lb.	.07½	—	.10
Phosphoric, ref. 50 per cent	lb.	.35	—	.40
Picric	lb.	.75	—	.85
Pyrogallic, resublimed	lb.	3.25	—	3.50
Sulphuric, 60 deg works	ton	14.00	—	16.00
Sulphuric, 66 deg works	ton	26.00	—	
Sulphuric, oleum (Fuming), tank cars	ton	60.00	—	65.00
Tannic, U. S. P., bulk	lb.	1.40	—	1.50
Tartaric, crystals	lb.	.85	—	.87
Tungstic, per lb. of W	lb.	1.70	—	1.75
Alcohol, sugar cane, 188 proof	gal.	4.85	—	
Alcohol, wood, 95 per cent	gal.	1.20	—	1.22
Alcohol, denatured, 180 proof	gal.	.56	—	.60
Alum, ammonia lump	lb.	.05½	—	.06
Alum, chrome ammonium	lb.	.17½	—	.18
Alum, chrome potassium	lb.	.20	—	.22
Alum, chrome sodium	lb.	.12½	—	.13
Alum, potash lump	lb.	.09½	—	.10
Aluminium sulphate, technical	lb.	.02¼	—	.02½
Aluminium sulphate, iron free	lb.	.03½	—	.03¾
Ammonia aqua, 26 deg., carboys	lb.	.07	—	.08½
Ammonia, anhydrous	lb.	.40	—	.45
Ammonium carbonate	lb.	.13	—	.14
Ammonium nitrate	lb.	.16	—	.17
Ammonium, sulphate domestic	lb.	.06	—	.07
Amyl acetate	gal.	3.75	—	4.25
Arsenic, white	lb.	.10	—	.11
Arsenic, red	lb.	.65	—	.70
Barium carbonate, 99 per cent	ton	80.00	—	90.00
Barium carbonate, 97-98 per cent	ton	65.00	—	67.00
Barium chloride	ton	65.00	—	75.00
Barium sulphate (Blanc Fixe, Dry)	lb.	.04½	—	.05
Barium nitrate	lb.	.10	—	.11
Barium peroxide, basis 70 per cent	lb.	.30	—	.32
Bleaching powder, 35 per cent chlorine	lb.	.02	—	.03½
Borax, crystals, sacks	lb.	.08¼	—	.08¾
Brimstone, crude	ton	65.00	—	70.00
Bromine, technical	lb.	.65	—	
Calcium, acetate, crude	lb.	.04	—	.05
Calcium, carbide	lb.	.10½	—	.11½
Calcium chloride, 7-75 per cent, fused, lump	ton	22.00	—	24.00
Calcium peroxide	lb.	1.50	—	1.70
Calcium phosphate	lb.	.22	—	.23
Calcium sulphate, 98-99 per cent	lb.	.09	—	.09½
Carbon bisulphide	lb.	.08	—	.09
Carbon tetrachloride, drums	lb.	.15	—	.16
Carbonyl chloride (phosgene)	lb.	.75	—	1.00
Caustic potash, 88-92 per cent	lb.	.62	—	.65
Caustic soda, 76 per cent	100 lb.	3.15	—	3.25
Chlorine, liquid	lb.	.10	—	.12
Cobalt oxide	lb.	1.60	—	1.65
Copperas	lb.	.01½	—	.02½
Copper carbonate	lb.	.30	—	.31
Copper cyanide	lb.	.75	—	.78
Copper sulphate, 99 per cent, large crystals	lb.	.08¼	—	.08½
Cream of tartar, crystals	lb.	.60½	—	.63
Epsom salt, bags, U.S.P	100 lb.	2.75	—	
Formaldehyde, 40 per cent	lb.	.21½	—	.22
Glauber's salt	lb.	.02	—	.02½
Glycerine, bulk, C.P	lb.	.20	—	.21
Iodine, resublimed	lb.	4.25	—	4.30
Iron oxide	lb.	.06	—	.08
Lead acetate, white crystal	lb.	.17	—	.17½
Lead arsenate (Paste)	lb.	.15	—	.18
Lead nitrate, C. P	lb.	.85	—	.86
Litharge, American	lb.	.11	—	.12
Lithium, carbonate	lb.	1.50	—	2.05
Magnesium carbonate, technical	lb.	.16	—	.17
Nickel salt, single	lb.	.14	—	.15
Nickel salt, double	lb.	.12	—	.13
Phosgene (see Carbonyl chloride)	lb.	.75	—	1.00
Phosphorus, red	lb.	.90	—	.95
Phosphorus, yellow	lb.	.75	—	.80
Potassium bichromate	lb.	.38	—	.40
Potassium bromide granular	lb.	1.25	—	1.26
Potassium carbonate calcined, 85-90 per cent	lb.	.38	—	.40
Potassium chlorate, crystals	lb.	.38	—	.40
Potassium cyanide, 98-99 per cent	lb.	.60	—	.70
Potassium iodide	lb.	3.75	—	3.80
Potassium muriate, 80-85 p. c. basis of 80 p. c	ton	300.00	—	350.00
Potassium nitrate	lb.	.27	—	.31
Potassium permanganate, U. S. P	lb.	1.10	—	1.20
Potassium prussiate, red	lb.	2.30	—	2.50
Potassium prussiate, yellow	lb.	.65	—	.75
Potassium sulphate, 90-95 p. c. basis 90 p.c	ton	Nominal		
Rochelle salts	lb.	.46½	—	.48
Salammoniac, gray gran	lb.	.16	—	.18
Salammoniac, white gran	lb.	.14	—	.16
Sal soda	100 lb.	1.15	—	1.20
Salt cake	ton	18.00	—	20.00
Silver cyanide, based on market price of silver	oz.			
Silver nitrate	oz.	.63½	—	.64
Soda ash, 58 per cent, light, flat (bags)	100 lb.	1.75	—	1.95
Soda ash, 58 per cent, dense, flat	100 lb.	3.35	—	3.50
Sodium acetate	lb.	.15	—	.18
Sodium bicarbonate, domestic	lb.	.02½	—	.03
Sodium bicarbonate, English	lb.			
Sodium bichromate	lb.	.17½	—	.18½
Sodium bisulphite, powd	lb.	.12	—	.14
Sodium chlorate	lb.	.18	—	.20
Sodium cyanide	lb.	.30	—	.35
Sodium fluoride, commercial	lb.	.16	—	.17
Sodium hyposulphite	lb.	3.10	—	3.50
Sodium molybdate, per lb. of Mo	lb.	2.50	—	
Sodium nitrate, 95 per cent	100 lb.	4.42	—	4.55
Sodium nitrite	lb.	.19	—	.20
Sodium peroxide	lb.	.35	—	.45
Sodium phosphate	lb.	.04	—	.04¼
Sodium prussiate, yellow	lb.	.30	—	.32
Sodium silicate, liquid (60 deg.)	lb.	.05	—	.06
Sodium sulphide, 30 per cent, crystals	lb.	.02	—	.03
Sodium sulphide, 60 per cent, fused	100 lb.	.05	—	.06
Sodium sulphite	lb.	.05½	—	.06
Strontium nitrate	lb.	.25	—	.30
Sulphur chloride, drums	lb.	.07½	—	.09
Sulphur dioxide, liquid, in cylinders	lb.	.15	—	.40
Sulphur, flowers, sublimed	100 lb.	4.35	—	4.50
Sulphur, roll	100 lb.	3.70	—	3.85
Sulphur, crude	ton	65.00	—	70.00
Tin bichloride, 50 deg	lb.	.28	—	.29
Tin oxide	lb.	.75	—	.76
Zinc carbonate	lb.	.18	—	.20
Zinc chloride	lb.	.15	—	.15½
Zinc cyanide	lb.	Nominal		
Zinc dust, 350 mesh	lb.	.13½	—	.14
Zinc oxide, American process XX	lb.	.10	—	.12
Zinc sulphate	lb.	.04½	—	.06½

Coal Tar Products (Crude)

Benzol, pure, water white	gal.	.22	—	.27
Benzol, 90 per cent	gal.	.25	—	
Toluol, in tank cars	gal.	.25	—	
Toluol, in drums	gal.	.30	—	.35
Xylol, pure, water white	gal.	.45	—	.55
Solvent naphtha, water white	gal.	.20	—	.25
Solvent naphtha, crude, heavy	gal.	.15	—	.17
Creosote oil, 25 per cent	gal.	.45	—	.55
Dip oil, 20 per cent	gal.	.35	—	.40
Pitch, various grades	ton	8.00	—	20.00
Carbolic acid, crude, 95-97 per cent	lb.	Nominal		
Carbolic acid, crude, 50 per cent	lb.	Nominal		
Carbolic acid, crude, 25 per cent	lb.	Nominal		
Cresol, U. S. P	lb.	.18	—	.20

Intermediates, Etc.

Alpha naphthol, crude	lb.	1.00	—	1.10
Alpha naphthol, refined	lb.	1.50	—	1.60
Alpha naphthylamine	lb.	.50	—	.55
Aniline oil, drums extra	lb.	.26	—	.30
Aniline salts	lb.	.36	—	.40
Anthracene, 80 per cent	lb.	.50	—	.55
Benzaldehyde (f.f.c.)	lb.	4.25	—	4.50
Benzidine, base	lb.	1.45	—	1.60
Benzidine, sulphate	lb.	1.15	—	1.25
Benzoic acid, U. S. P	lb.	1.80	—	1.90
Benzoate of soda, U. S. P	lb.	1.65	—	1.70
Benzyl chloride	lb.	1.00	—	
Beta naphthol benzoate	lb.	10.00	—	12.00
Beta naphthol, sublimed	lb.	.75	—	.85
Beta naphthylamine, sublimed	lb.	2.60	—	2.65
Dichlorbenzol	lb.	.15	—	.20
Diethylaniline	lb.	3.25	—	4.00
Dinitrobenzol	lb.	.36	—	.38
Dinitrochlorbenzol	lb.	.35	—	
Dinitronaphthaline	lb.	.55	—	.60
Dinitrotoluol	lb.	.40	—	.50
Dinitrophenol	lb.	.49	—	.50
Dimethylaniline	lb.	.57	—	.65
Diphenylamine	lb.	1.00	—	1.10
H-acid	lb.	2.35	—	2.75
Metaphenylenediamine	lb.	1.55	—	1.75
Monochlorbenzol	lb.	.16	—	.19
Naphthalene, flake	lb.	.09	—	
Naphthalene, balls	lb.	.12	—	.12½
Naphtionic acid, crude	lb.	1.20	—	1.30
Naphthylamin-di-sulphonic acid	lb.	1.00	—	1.10
Nitro naphthaline	lb.	.45	—	.50
Nitro toluol	lb.	.55	—	.60
Ortho-amidophenol	lb.	6.00	—	7.00
Ortho-dichlor-benzol	lb.	.15	—	.20
Ortho-toluidine	lb.	.50	—	.90
Ortho-nitro-toluol	lb.	.75	—	.85
Para-amidophenol, base	lb.	3.75	—	4.25
Para-amidophenol, H. C. L	lb.	3.75	—	4.25
Para-dichlor-benzol	lb.	.15	—	.20
Paranitraniline	lb.	1.40	—	1.60
Para-nitro-toluol	lb.	1.50	—	1.60
Paraphenylenediamine	lb.	3.25	—	3.50
Para toluidine	lb.	2.25	—	2.50
Phthalic acid anhydride	lb.	3.25	—	3.50
Phenol, U. S. P	lb.	Nominal		
Resorcin, technical	lb.	4.50	—	5.00
Resorcin, pure	lb.	7.00	—	8.00
Salicylic acid, U. S. P	lb.	.65	—	.75
Salol	lb.	1.50	—	2.00
Sulphanilic acid, crude	lb.	.25	—	.31
Toluidine	lb.	2.50	—	3.00
Toluidine-mixture	lb.	.80	—	1.00

Petroleum Oils

Crude (at the Wells)

Pennsylvania	bbl.	4.00	—	
Corning, Ohio	bbl.	2.85	—	
Somerset, Ky	bbl.	2.60	—	
Wooster, Ohio	bbl.	2.58	—	
Indiana	bbl.	2.28	—	
Illinois	bbl.	2.25	—	
Oklahoma and Kansas	bbl.	2.25	—	
Caddo, La., light	bbl.	2.10	—	2.25
Corsicana, Tex., light	bbl.	2.25	—	
California	bbl.	1.24	—	1.57
Gulf Coast	bbl.	1.35	—	
Mexican	bbl.	1.90	—	

Fuel Oil

New York	gal.	.15	—	
Philadelphia	gal.	.10½	—	
Baltimore	gal.	.07½	—	.15
Pittsburgh	gal.	.07½	—	.10½
Texas	bbl.	1.85	—	2.35
Los Angeles	bbl.	1.65	—	

Gasoline (Wholesale)

New York, motor	gal.	.24½	—	.....
Gas machine	gal.	.41½	—	.....
72-76 degrees	gal.	.33½	—	.39½
70-72 degrees	gal.	.32	—	.37½
67-70 degrees	gal.	.30½	—	.36½
Pittsburgh, motor	gal.	.25½	—	.....
Chicago, motor	gal.	.21	—	.....
Oklahoma, motor	gal.	.23½	—	.....
San Francisco, motor	gal.	.20½	—	.....

Paraffine Waxes

Crude, 103 to 105 deg. m.pt	lb.	.08½	—	.09
Crude, 118 to 120 deg. m.pt	lb.	.09½	—	.10
Crude, 124 to 126 deg. m.pt	lb.	.10	—	.....
Refined, 120 deg. m.pt	lb.	.13½	—	.....
Refined, 128 deg. m.pt	lb.	.14	—	.....
Refined, 135 deg. m.pt	lb.	.16	—	.16½
Ozokerite, brown	lb.	.75	—	.80
Ozokerite, green	lb.	.85	—	.90

Lubricants

Black, reduced, 29 gravity, 25-30 cold test	gal.	.24	—	.25
Cylinder, light	gal.	.42	—	.44
Cylinder, dark	gal.	.39	—	.43
Paraffine, high viscosity	gal.	.40	—	.41
Paraffine, 0.903 sp. gr	gal.	.36	—	.38
Paraffine, 0.885 sp. gr	gal.	.26	—	.28

Flotation Oils

(Prices at New York unless otherwise stated)

Pine oil, crude, f. o. b. Florida	gal.	.44	—	.....
Pine oil, steam-distilled, sp. gr. 0.925-0.940	gal.	.58	—	.60
Pine oil, destructively distilled	gal.	.58	—	.60
Pine-tar oil, sp. gr. 1.02-1.035	gal.	.35	—	.....
Pine-tar oil, double refined, sp. gr. 0.965-0.990	gal	.42	—	.....
Pine-tar oil, ref., light, sp. gr. 0.950, tank cars, f.o.b. works	gal.	.37	—	.....
Pine-tar oil, ref., heavy, sp. gr. 1.025, tank cars, f.o.b. works	gal.	.28	—	.....
Pine-tar oil, ref., thin, sp. gr. 1.060-1.080	gal.	.32	—	.....
Turpentine, crude, sp. gr. 0.870-0.900	gal.	.45	—	.....
Hardwood oil, f.o.b. Michigan, sp.gr. 0.960-0.990	gal.	.23	—	.....
Hardwood oil, f.o.b. Michigan, sp.gr. 1.06-1.08	gal.	.23	—	.....
Wood creosote, ref., f.o.b. Florida	gal.	.31	—	.....

Naval Stores

Rosin A-E barrel	280 lb.	14.00	—	14.20
Rosin F-I	280 lb.	14.20	—	14.75
Rosin K-N	280 lb.	16.70	—	17.25
Rosin WG-W	280 lb.	17.75	—	.....
Spirits of turpentine	gal.	.74	—	.75
Wood turpentine, steam distilled	gal.	.68	—	.69
Wood turnpentine, destructively distilled	gal.	.63	—	.65½
Pitch	bbl. 200 lb.	8.00	—	.....
Tar, kiln dried	280 lb.	13.00	—	13.50
Retort tar	280 lb.	14.00	—	14.50
Rosin oil, first run	gal.	.77	—	.....
Second run	gal.	.80	—	.....
Third run	gal.	.85	—	.....
Fourth run	gal.	.95	—	.....

Vegetable Oils

Castor oil	lb.	.25	—	.26
China wood oil	lb.	.23	—	.24
Cocoanut oil	lb.	.16	—	.21
Corn oil	lb.	.18	—	.....
Cottonseed oil, crude	lb.	.17½	—	.22
Linseed oil, raw, cars	gal.	1.45	—	1.48
Palm	lb.	.18	—	.21½
Peanut oil, crude	lb.	.17½	—	.21
Soya bean oil, Manchuria	lb.	.14	—	.15

Glues

Extra white	lb.	.31	—	.35
Cabinet	lb.	.25	—	.26
Brown foot stock	lb.	.15	—	.19
Fish glue, 50-gal. barrels	gal.	1.00	—	1.50

Miscellaneous Materials

Barytes, floated, white, foreign	ton	Nominal		
Barytes, floated, white, domestic	ton	33.00	—	36.00
Beeswax, white, pure	lb.	.63	—	.65
Beeswax, unbleached	lb.	.43	—	.48
Blanc fixe	lb.	.05½	—	.....
Casein	lb.	.17½	—	.30
Ceylon graphite	lb.	.07½	—	.25
Chalk, light, precipitated, English	lb.	.04½	—	.06
China clay, imported, lump	ton	20.00	—	40.00
China clay, domestic, lump	ton	15.00	—	22.50
Feldspar	ton	8.00	—	12.00
Fluorspar, gravel, f. o. b. mines	ton	28.00	—	40.00
Fluorspar, washed, powdered	ton	90.00	—	.....
Fuller's earth, powdered	100 lb.	1.50	—	2.00
Japan wax	lb.	.26	—	.27
Mexican graphite	ton	60.00	—	75.00
Madagascar graphite	lb.	.10	—	.15
Orange shellac	lb.	.72	—	.80
Pumice stone	lb.	.04	—	.08
Red lead, dry, carloads	100 lb.	.11½	—	.11½
Soapstone	ton	15.00	—	25.00
Stearic acid, 120 deg. m.pt	lb.	.13	—	.14
Stearic acid, 140 deg. m.pt	lb.	.18	—	.19
Talc, American, white	ton	20.00	—	40.00
White lead, dry	lb.	.14	—	.14½

Refractories, Etc.

(F.O.B. Works)

Chrome brick	net ton	175.00	—	.....
Chrome cement	net ton	75.00	—	.....
Clay brick, first quality fireclay	per 1000	50.00	—	55.00
Clay brick, second quality	per 1000	35.00	—	40.00
Magnesite, raw	ton	30.00	—	35.00
Magnesite, calcined, powdered	ton	50.00	—	65.00
Magnesite, dead burned	net ton	50.00	—	60.00
Magnesia brick, 9x4½x2½	net ton	110.00	—	125.00
Silica brick	per 1000	50.00	—	60.00

Ferroalloys

Ferrocarbontitanium, 15-18 per cent, carloads, f. o. b. Niagara Falls, N. Y	ton	200.00	—	250.00
Ferrocerium	lb.	15.00	—	30.00
Ferrochromium, per lb. of Cr	lb.	.30	—	.40
Ferromanganese, domestic, 70 per cent basis	ton	150.00	—	200.00
Ferromanganese, English	ton	.....	—	.....
Spielgeleisen (16-18%)	ton	60.00	—	.....
Ferromolybdenum, per lb. of Mo	lb.	3.50	—	4.50
Ferrosilicon, 75 per cent, f. o. b. N. Y	ton	.....	—	.....
Ferrosilicon, 50 per cent, contract	ton	125.00	—	.....
Ferrotungsten, 75-85 per cent, f.o.b. Pittsburgh	lb.	Nominal		
Ferrouranium, f.o.b. works, per lb. of U	lb.	7.50	—	.....
Ferrovanadium, f.o.b. works	lb.	.....	—	.....

Ores and Semi-finished Products

Chrome ore, 45 per cent minimum, fo.b. Cal. per unit	ton	1.50	—	1.55
Coke	ton	6.00	—	7.00
Petroleum Coke	ton	16.00	—	.....
Manganese ore, 48 per cent and over, per unit	ton	1.20	—	.....
Manganese ore, chemical	ton	80.00	—	100.00
Molybdenite, per lb. of MoS_2	lb.	1.25	—	1.50
Tungsten, Scheelite, per unit of WO_3	ton	17.00	—	24.00
Tungsten, Wolframite, per unit of WO_3	ton	15.00	—	21.00
Uranium oxide, 96%	lb.	3.25	—	3.60
Vanadium pentoxide, 99%	lb.	10.50	—	.....
Pyrites, foreign	unit	.17	—	.....
Pyrites, domestic	unit	.28	—	.30½

Plant Supplies

BUILDING MATERIALS

Common clay bricks	M	14.00	—	15.00
Faced Brick	M	37.00	—	46.00
Hollow tile, 4x12x12	M	60.00	—	.....
Hollow tile, 12x12x12	M	170.00	—	.....
Lime	ton	16.50	—	.....
Portland cement	bbl.	2.59	—	.....
Single glass (82-lb.), 10x26-16x24		21.00	—	27.00
Double glass (164 lb.), 10x26-16x29		31.00	—	39.00
Yellow pine lumber	M	39.00	—	45.00
Cypress	M	70.00	—	.....
Tarred felt (14-lb. sq.)	ton	68.00	—	.....
Roofing pitch	ton	27.00	—	.....
Asphalt coated roofing (35-55-lb.sq.)	sq.	1.60	—	2.45
Slate surfaced asphalt shingles	sq.	5.25	—	5.50
Corrugated galvanized iron	ton	109.00	—	127.00
Putty	100 lb.	6.25	—	.....
Red oxide (Ppte. Copperas)	100 lb.	15.00	—	20.00
Native red oxide	100 lb.	3.25	—	8.00
Red metallic paint	100 lb.	1.20	—	1.50
White lead in oil	100 lb.	15.00	—	16.00
Red lead in oil	100 lb.	12.28	—	14.50
Zinc oxide (dry)	100 lb.	13.00	—	14.50
Zinc oxide—leaded	100 lb.	9.00	—	10.00
Yellow ochre	100 lb.	1.50	—	10.00
Ultra marine blue	100 lb.	14.00	—	50.00
Prussian blue	100 lb.	135.00	—	150.00
Chrome green	100 lb.	40.00	—	70.00
Paris green	100 lb.	43.00	—	49.00
Mineral black	100 lb.	1.75	—	2.25
Powdered bone black	100 lb.	5.50	—	12.00
Lampblack	100 lb.	15.00	—	45.00
Gas carbon	100 lb.	16.00	—	25.00
Mexican petroleum pitch	100 lb.	1.00	—	2.00
Gilsonite	100 lb.	2.00	—	2.50
Coal tar pitch	100 lb.	.60	—	1.25

STRUCTURAL IRON

Blue annealed sheet iron	ton	77.00	—	82.00
Black sheet iron	ton	90.00	—	96.00
Galvanized iron	ton	101.00	—	131.00
Tern plate, 8-lb. coating	ton	145.00	—	148.00
Tern plate, 15-lb. coating	ton	175.00	—	.....
Tern plate, 25-lb. coating	ton	200.00	—	.....
Tern plate, 40-lb. coating	ton	230.00	—	.....
Tin plate, prime	ton	147.00	—	155.00
Tank plates	ton	60.00	—	65.00
Beams, channels, angles, T's, Z's	ton	56.00	—	60.00
Rivets	ton	88.00	—	92.00
Steel pipe, ¾ to 3-inch	ton	51.00	—	.....
Bar iron and steel	ton	60.00	—	70.00
Chain (1 inch proof coil)	ton	150.00	—	.....
Nails, bolts, nuts, washers	ton	70.00	—	80.00
Tool steel, special alloys	ton	300.00	—	500.00
Bessemer pig iron	ton	32.00	—	35.20
Bessemer steel	ton	43.50	—	47.50
No. 2 foundry	ton	37.90	—	.....
Steel billets (4 x 4)	ton	47.50	—	.....

POWER HOUSE SUPPLIES

Steam packing, rubber duck	lb.	.99	—	1.10
Asbestos, high pressure	lb.	1.76	—	.....
Asbestos, wired	lb.	1.30	—	.....
Asbestos, graphited braid	lb.	1.21	—	.....
Asbestos, wick	lb.	.75	—	.....
Rubber, sheet	lb.	.66	—	.....
Cup grease	lb.	.07	—	.....
Transmission grease	lb.	.07	—	.....
Axle grease	lb.	.04½	—	.....
Gear grease	lb.	.04½	—	.....
Cotton waste	lb.	.08½	—	.11
Hose, underwriters, 2½ in	ft.	.75	—	.....
Hose, air, ¾ in	ft.	.50	—	.60

INDUSTRIAL

Financial, Construction and Manufacturers' News

Construction and Operation

Arizona

GLOBE.—The city has awarded the contract for the construction of a sanitary sewerage system and sewage disposal plant, to include two Imhoff tanks, two sludge beds, one chlorinator house, etc., to the Clark & Henery Construction Co., Stockton, Calif. Estimated cost, $226,530. Noted Nov. 30.

PHOENIX.—The United Verde Extension Mining Co. has awarded the contract for constructing various buildings at its mine here, to Paul Michelson, Phoenix, percentage basis. About $500,000 will be expended.

Colorado

BOULDER.—The Colorado Pitchblend Co. will build a concentration mill at its mine at Jamestown and is in the market for milling equipment and lumber. Estimated cost, $300,000. J. F. Barnhill, manager.

TELLURIDE.—The Tomboy Gold Mines Co., Ltd., will build a new mill at its mine at Savage Basin and is in the market for oil flotation equipment. Estimated cost, $150,000. D. A. Herron, manager.

Connecticut

BRIDGEPORT.—The Bridgeport Hospital, Grant St., will build a pathological laboratory on Mill Hill Ave. Estimated cost, $50,000.

Illinois

ALTON.—The Western Cartridge Co. will build an addition to its brass mill and convert part of its present plant into a factory for the manufacture of brass novelties.

CHICAGO.—Goldsmith Bros. Smelting & Refining Co., 29 East Madison St., will build a 125 x 150 ft. plant addition, on 59th St. and Throop St. A. Woltersdorf, 138 North La Salle St., architect.

CHICAGO—The Trustees of the University of Chicago, 134 South La Salle St., will build a laboratory and hospital near the Cook County Hospital. Estimated cost, $400,000.

CHICAGO HEIGHTS.—The Armour Fertilizer Works, Union Stock Yards, Chicago, is having plans prepared for the construction of a one-story, 240 x 520 ft. fertilizer plant. Estimated cost, $500,000. R. C. Clark, c/o company, architect.

WOODRIVER.—The Tidewater Oil Co., Constable Hook, Bayonne, N. J., will build an oil refinery here and extend its pipe line from Woodriver to Tulsa, Okla.

Indiana

LAFAYETTE.—C. S. Barnes is in the market for a second-hand concentration and flotation mill.

Kansas

COTTONWOOD FALLS.—The city has retained Black & Veatch, engineers, Interstate Building, Kansas City, Mo., to prepare plans for complete sewerage system and sewage disposal plant. W. P. Penny, city clerk.

PRATT.—The city has awarded the contract for the construction of a new school, to include a chemical laboratory, to William Foley Construction Co., Dodge City. Estimated cost, $157,087.

Maryland

BALTIMORE.—The city is having plans prepared by L. J. Houston, Jr., engineer, 602 Parkwyrth Ave., for the construction of a sewage disposal plant. Estimated cost, $80,000.

BALTIMORE.—The city will build thirty-two filter operating tables for the Lake Montebello filters. Estimated cost, $26,000. Walter E. Lee, City Hall, engineer.

BALTIMORE.—The Hess Steel Corporation, Biddle St. and Loneys Lane, will receive bids in February for enlarging its plant. Improvements include several one story steel and reinforced-concrete buildings to conform with present structures, additional electric furnaces, rolling mills, etc Estimated cost between $100,000 and $150,000.

Michigan

DETROIT.—Fire recently damaged the chemical plant of F. F. Ingraham Co., 409 West Lafayette Ave. Loss, $100,000.

PONTIAC—The city will install Imhoff tanks and build extensions to treat sewage and prevent dumping it into the Clinton River. Estimated cost, $250,000. H. H. Barnett, City Hall, engineer.

WYANDOTTE.—The city has awarded the contract for the construction of an addition to its filtration plant and pumping station,to the Pitt Construction Co., Fulton Building, Pittsburgh, Pa. Estimated cost, $250,000. Noted Oct. 15.

WYANDOTTE.—The city has awarded the contract for the construction of a rapid sand filtration plant, also an addition to the existing pumping station, to the Pitt Construction Co., Fulton Building, Pittsburgh, Pa. Estimated cost, $185,484. Noted Dec. 15.

Minnesota

CUYUNA.—The Northern Minnesota Ore Co. plans to construct a crushing plant at its Northland Mine and is in the market for grizzlys, feeders, crushers, picking belts, conveyor belts, etc. Estimated cost, $10,000. A. K. Knickerbocker, superintendent.

MANGANESE—The village will soon award the contract for the construction of a sewerage system, to include a sewage disposal plant, septic tank, etc. J. F. Wolff, engineer.

Missouri

CAVE SPRINGS (Chitwood P. O.)—E. James, Connor Hotel, Joplin, will move and erect a complete second-hand mill here.

KANSAS CITY.—The city will build a complete sewerage system and disposal plant. W. B. Penny, city clerk.

VALLEY PARK.—The Universal Glass Company, of Pennsylvania, has acquired a glass plant here comprising eleven acres, and will reopen, remodel and reequip same for its own use. Address owners through R King Kauffman, Mercantile Trust Building, St. Louis.

WACO.—The Waco Mining Co. will build a complete new mill and is in the market for engines, boilers, hoists, crushers, rolls, pumps, rock drills, etc. P. B. Butler, manager.

WEBB CITY.—Crocker Bros. have submitted a plan to the Chamber of Commerce for the construction of a fertilizer plant here, in connection with their packing plant. Project will be investigated. Estimated cost, $50,000.

Montana

HAVRE.—The Board of Health will submit plans not later than May 1, for the installation of a sewage disposal plant. C. W. Swearingen, city engineer.

Nebraska

LAKESIDE.—The Omaha Potash & Refining Co. will install evaporators, coal handling machinery, dryers, crushers, oil engines, etc., in the plant which it plans to build 20 miles south of here. Total estimated cost, $1,000,000. D. E. Wynn Jones, superintendent. Noted Jan. 15,

Nevada

PIOCHE.—The Virginia-Louise Mining Co. plans to install a new compressor plant and enlarge the ore bins at its mine about 4 mi. southwest of Pioche. R. T. Walker, superintendent.

PIONEER.—The Consolidated Mayflower Mines Co. plans to rehabilitate its mine here. Improvements include a new ball or tube mill, new regrinding machinery and the possible enlargement of the regrinding plant. Estimated cost, $10,000. J. B. Kendall, manager.

New Jersey

JERSEY CITY—The Hoboken Electric Chemical Co. submitted lowest bid for supplying Water Department with chloral lime, at 9c. per lb. for liquid chloride and 2.8c. per lb. for bleaching powder.

LINDEN.—The Transatlantic Chemical Co. has awarded the contract for the construction of a two story, 100 x 150 ft. factory, to M. Byron & Co., 430 Westfield Ave., Elizabeth. Estimated cost, $100,000.

NEW BRUNSWICK.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., has awarded the contract for the construction of a sewage disposal plant at the barracks, here, to Hugh S. Roberts & Co., 1122 Broadway, New York City, N. Y.

New York

NEW YORK.—Bids will be received by Nicholas J. Hayes, Commissioner of Water Supply, Gas & Electricity, Room 2351, Municipal Building, until Feb. 5, for furnishing and delivering liquid chlorine and chloride of lime.

BROOKLYN.—Moller & Schuman, Gerry and Wallabout St., will alter and build extensions to their varnish plant. Estimated cost, $80,000.

CENTRAL ISLIP.—The State Hospital Commission, Albany, has applied to the State Legislature for an appropriation of $100,000 to build underground sewers, etc., and $50,000 for changes in the sewage disposal plant, at Central Islip State Hospital.

NEW YORK.—The Beth Israel Hospital, 70 Jefferson St., will install a laboratory in the sixteen story, 175 x 200 ft. hospital, which it plans to build on Livingston Pl. between 16th and 17th Sts. Total estimated cost, $1,000,000. Louis Abramson, 220 5th Ave., engineer.

NIAGARA FALLS.—The Titanium Alloys Manufacturing Co., 2950 Sugar St., will build a two story, 50 x 50 ft. addition to its plant.

POUGHKEEPSIE.—Bids will soon be received by L. F. Pilcher, state architect, Capitol, Albany, for the construction of a filtration plant and reservoir for the Hudson River State Hospital, here. Estimated cost, $50,000.

RAY BROOK.—The State Hospital Commission, Albany, has applied to the State Legislature for an appropriation of $25,000 to install a new Imhoff system for the sewage disposal at the New York State Hospital for the Treatment of Incipient Tuberculosis.

SYRACUSE.—The Intercepting Sewer Board and the Board of Estimate and Apportionment plan to construct a modern sewage disposal plant at Lake View Point, complete Onondaga Creek improvement and immediate diversion of sewage from barge canal harbor to temporary clarification plant on salt sands.

UTICA.—The State Hospital Commission, Capitol, Albany, will build a two story, 44 x 60 ft. laboratory at the Utica State Hospital. Estimated cost, $50,000.

Ohio

OBERLIN—The Board of Education is having plans prepared by F. C. Warner, architect, 767 Hippodrome Annex, Cleveland, for a two story, 75 x 180 ft. high school building, including chemistry, botany and agricultural laboratories, etc. Total estimated cost, $225,000.

CLEVELAND.—The Board of Public Service, City Hall, will build a filtration plant at the foot of East 49th St., having a daily capacity of 160,000,000 gallons. Estimated cost, $3,500,000. F. H. Betz, 604 City Hall, architect.

CLEVELAND.—The Board of Public Welfare, City Hall, will build a four story addition to the City Hospital, consisting of laboratory, convalescing ward, etc. Total estimated cost, $300,000. Frederich H. Betz, 604 City Hall, architect and engineer.

CLEVELAND.—The Glass Coating Co., 1209 Rockefeller Building, has awarded the contract for the construction of a one story, 165 x 240 ft. glass factory at St. Clair Ave. and Nickel Plate R. R., to include a chemical laboratory, to Harold Ferguson, 66 Beersford Rd. Estimated cost, $80,000.

Oklahoma

DUNCAN.—The city will soon award the contract for the construction of a sewage disposal plant. Estimated cost, $50,000. J. L. Davis, city clerk. Benham Engineering Co., Colcord Building, Oklahoma City, engineer.

IDABEL.—The city is having preliminary plans prepared by the Benham Engineering Co., engineer, Colcord Building, Oklahoma City, for the construction of a complete sewerage system, including main and lateral sewers and a sewage disposal plant. T. J. Bookout, city clerk.

INOLA.—The Liberty Oil & Carbon Co. will build a refinery. Estimated cost, $250,000.

PICHER.—The King Brand Mining Co. of Picher, and Jefferson City, Mo., will open a zinc and lead mine in the Picher District and will soon be in the market for a 200-ton concentrating plant. Address D. M. Oberman, Jefferson City, Mo.

PICHER.—The Oklahoma Lead & Zinc Co. will move its mill from Commerce and erect same here. The company is in the market for boilers, engines, compressors and tables. T. F. Lennan, manager.

TAR RIVER—The Alexander Mining Co. will move its mill from the Arkansas field and erect same at Tar River. The company is in the market for compressors, engines, rolls, pumps and screens. Estimated cost, $60,000. G. B. Ramsey, manager.

Pennsylvania

BRIGHTON.—The city plans to construct a garbage disposal plant. R. Winthrop Pratt, 716 Hippodrome Building, Cleveland, Ohio, engineer.

WOODLAWN.—The borough has had plans prepared for the construction of a sewage disposal plant. Estimated cost, $50,000. W. M. Anderson, borough engineer.

Tennessee

NEWPORT.—The Unaka Tanning Co. will rebuild its plant recently destroyed by fire. Loss between $300,000 and $500,000.

Texas

DAMON MOUND.—The Universal Sulphur Products Co., incorporated by W. C. Hardcastle, and H. T. Staiti, Chronicle Bldg., Houston, with a capital of $12,000,000, will develop a 7000 acre tract and install a plant for mining raw products, refining it and manufacturing sulphuric acid.

FT. WORTH.—The city is having preliminary surveys made for the construction of a sewage disposal plant. F. J. Von Zuben, city engineer.

HOUSTON.—The Clarendon Refining Co., Clarendon, Pa., has purchased the property of the Crown Oil & Refining Co. and will build a refinery, having a capacity of 5000 barrels. G. E. Colvin, president.

McKINNEY.—A. E. Boger, Dallas, will build a refinery. Estimated cost, $500,000.

RANGER.—Plans are being considered by the City Commissioners for the installation of a new sewerage system and sewage disposal plant.

Virginia

MONTEBELLO.—Richards & Co., Inc., has taken over the Irish Creek Tin Mines and plans to develop same, to include the installation of air drills and the usual equipment. Wiley S. Young, 200 Causeway St., Boston, Mass., treasurer.

NORFOLK.—The Hubbard Fertilizer Co., 802 Keyser Building, Baltimore, Md., has awarded the contract for the construction of a 150 x 192 ft. fertilizer plant at Money Point, near here. W. T. Gregory, 501 Law Building.

Wisconsin

MADISON.—The city plans to improve the sewage disposal plant. Estimated cost, $10,000. E. E. Parker, city engineer.

MILWAUKEE.—The National Oil Products Co., 220 Broadway, New York City, N. Y., has purchased a ten acre site at Keefe and Humboldt Aves., on which it will construct a modern chemical plant. Estimated cost, $100,000.

WAUSAU.—The city plans to install a filtration plant and air lift system to have a capacity or 4,000,000 gallons; also two reservoirs having a capacity of 250,000,000 gallons. W. G. Kirchoffer, Madison, engineer.

Wyoming

ROCK RIVER.—The Midwest Refining Co. has purchased a site of thirty-eight acres here on which an oil refinery will be constructed.

British Columbia

MERRITT.—The Aberdeen Mines, Ltd., will build a copper mill in the spring. Estimated cost, $100,000. T. J. Corwin, manager.

VANCOUVER.—The International Food Products Co., Ltd., will build a vegetable oil plant to cost $20,000. Machinery costing $20,000 will be installed in same. Singer, Perlstein & Co., c/o the company, architect.

New Brunswick

NASHWAAK.—The Nashwaak Pulp & Paper Co. plans to construct a new mill. Estimated cost, $40,000. N. M. Jones, general manager.

Newfoundland

ST. JOHN'S.—Captain Storm will build a pulp and paper mill on the Terra Nova River. Estimated cost, $1,000,000.

ST. JOHN'S.—The Imperial Oil Co., 56 Church St., Toronto, Ont., will build an addition to its plant here. Estimated cost, $50,000.

Ontario

HAMILTON.—The City Council plans to reconstruct the sewerage system and install a modern sewage disposal plant. E. R. Gray, city engineer.

HAMILTON.—The Dominion Foundries & Steel Co., Ltd., will install a plate mill to roll 42-inch universal and 84-inch sheared plates, and will have a capacity of from 10,000 to 12,000 tons a month.

LINDSAY.—Plans are being considered by the city for the construction of a new sewage disposal plant.

PETERBOROUGH.—The Utilities Commission has purchased the old Carnegie property at the north end of the city and will use same for the construction of a filtration plant.

Saskatchewan

SHAUNAVON.—L. C. Robinson, Calof Building, 3rd Ave., will install a complete new vulcanizing plant and is in the market for machinery.

Coming Meetings and Events

THE AMERICAN CERAMIC SOCIETY will hold a meeting at Pittsburgh, Pa., Feb. 3, 4 and 5, jointly with the U. S. Potters' Association. Following are the professional divisions with their representative chairmen: White-ware and porcelain, Mr. C. L. Sebring; refractories, Mr. A. V. Bleininger; glass technology, Mr. C. H. Kerr; abrasives, Mr. R. C. Purdy; enameled metals, Mr. R. D. Landrum; Terra Cotta and Faience, Mr. F. B. Ortman; brick and tile, Mr. M. P. Blair. Other annual meetings held at the same time are the National Brick Manufacturers' Association, National Paving Brick Manufacturers' Association, National Building Brick Bureau and the National Clay Machinery Manufacturers' Association. There will be an opportunity to inspect the laboratories of the Bureau of Standards, Mellon Institute, University of Pittsburgh.

THE AMERICAN ELECTRO-PLATERS' SOCIETY, NEW YORK BRANCH, will have its 10th annual banquet at the Broadway Central Hotel, Saturday, Feb. 22, at 7:30 p. m.

THE AMERICAN INSTITUTE OF MINING ENGINEERS, which includes the Institute of Metals Division, will meet at the New York Headquarters, 29 West 39th St., Feb. 17 to 20 inclusive.

THE CANADIAN MINING INSTITUTE will hold its twenty-first annual meeting on March 5 to 7, 1919.

THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will meet at the Waldorf-Astoria and the Hotel Astor, Feb. 3, 4, 5 and 6, 1919.

Industrial Notes

W. S. BARSTOW & Co. announces the completion of a potash recovery plant for the Ironton Portland Cement Co. The Cottrell system of electrical precipitation is used. It is expected that the product will amount to about 30,000 pounds of dust per day and as the raw material is unusually high in potash a large output of this mineral is expected.

E. I. DU PONT DE NEMOURS & Co., Wilmington, Del., has made application to the Federal Trade Commission for enemy patent licenses covering 148 dye patents.

THE AMERICAN PIPE BENDING MACHINE Co., with offices at 39 Pearl St., Boston, Mass., is about to open pipe-bending plants in all large cities throughout the country. The first plant is about ready for operation at Lowell, Mass. "Wonder" pipe benders, manufactured by this company, will be used at all plants. The company will make a specialty of furnishing bent pipe and make delivery of small orders on 48 hours' notice. Each plant will have facilities for turning out from 1000 to 3000 bends per day, and will be in charge of an expert pipe bender. The present company has been capitalized at $100,000, the old company is about to be re-organized with a capital of $1,000,000 to carry on this business.

THE ELECTRIC FURNACE Co., Alliance, Ohio, has closed a contract with the Standard Roller Bearing Co. of Philadelphia for 190 kw. continuous, automatic, heat-treating equipment. The set consists of one 150-kw. electric furnace for hardening and one 40-kw. electric heated oil-drawing bath. There is supplied in addition an oil-quench bath located between the furnace and the electric-heated, oil-drawing bath. Material, which consists of alloy steel balls and ball races, is automatically handled through the furnaces, quench, and drawing baths, in metal baskets.

THE DRAEGER OXYGEN APPARATUS CO., 309 Broadway, has changed its name to the American Atmos Corporation.

THE DETROIT RANGE BOILER & STEEL BARREL Co., Detroit, Mich., is a new company, consolidating the old Detroit Range Boiler Co. and the Toledo Steel Barrel Co. The new organization is capitalized at $1,000,000 and its officers are Edward W. Stoddard, president; Frederick G. Wacker, vice-president; D. B. Duffield, treasurer, and George A. Moore, secretary. At Detroit the company will manufacture the "Perfect" metal bilge barrel and at the Toledo plant they will make "Detroit" drums. There will be branch offices in Philadelphia, Chicago, St. Louis and San Francisco.

THE ASPROMET COMPANY of Pittsburgh, Pa., announces the opening of a sales office in the Schmulbach Building, Wheeling, W. Va., under the direction of Mr. E. A. Short.

THE HAUSER-STANDER TANK Co., Cincinnati, Ohio, has recently moved into enlarged and up-to-date quarters covering about three acres of ground.

THE FULLER-MACCULLOCH Co., Denver, Colo., are erecting in Denver a plant for the manufacture of potash salts, by a new electrochemical process, and in addition are producing phosphates and other like products. They desire catalogs and other literature relating to milling machinery, such as crushers, pulverizers, filters, dryers and evaporating machines.

THE QUIGLEY FURNACE SPECIALTIES Co. has opened a branch office in Providence, R. I., at 302 Turks Head Bldg., in charge of Mr. F. W. Reisman, who has been the Quigley Co.'s Eastern New England representative for hytempite (high-temperature fire brick cement) and insulating brick as well as the air transport system for distributing and burning powdered coal and other fuels.

THE MAYWOOD CHEMICAL WORKS, Maywood, N. J., is the name for the consolidation of the Schaefer Alkaloid Works, the Standard Essence Co. and the Thorium Chemical Co.

THE G. A. BURRELL Co., in cooperation with the R. H. Brownlee Laboratories, has installed at Pittsburgh, Pa., complete equipment for the laboratory and plant testing of chemical processes and especially natural gas, gasoline and petroleum products. It is prepared to handle all problems in connection with these latter substances. Col. G. A. Burrell recently left the Service, where he had charge of the research division of the Chemical Warfare Service. Prior to that time he was in consulting chemical engineering practice, following ten years in the U. S. Bureau of Mines in charge of gas investigations. Dr. R. H. Brownlee spent four years in the laboratories and plant of the Standard Oil Co.'s refinery at Whiting, Ind. Since that time he worked at the Mellon Institute on a gas fellowship, following which he became director of research and development for the Benedum-Trees interests in Pittsburgh, Pa.

THE WHEELER CONDENSER & ENGINEERING Co. of Carteret, N. J., announces that it has obtained from the Schutte & Koerting Co., of Philadelphia, through the Alien Property Custodian, the exclusive right to manufacture and sell steam jet air pumps under Patent No. 968,926 in connection with surface condensers, jet condensers, barometric condensers, vacuum pans and evaporating apparatus.

THE UNIVERSAL ENGINEERING CORPORATION, 1229 Calvert Building, Baltimore, Md., has been organized by John F. Dizzu-

welt, William W. Varney, Raymond M. Glacken and Frederick E. Fisher. The company will conduct a general engineering business and research laboratory, and is especially well equipped to solve all problems in connection with electrochemical, metallurgical, mechanical and high-temperature engineering, also the handling of patents, foreign and domestic, investigation, appraisement, litigation, constructing and re-constructing of industrial plants, converting of breweries and distilleries into modern food products plants, etc.

THE LUDLUM STEEL CO., Watervliet, announces the following branches and branch managers: New England territory, Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.; New York, Connecticut and New Jersey territory, Arthur A. Colebrook, 2 Rector St., New York City; Philadelphia territory, E. L. Milnor, 1517 Real Estate Trust Bldg., Philadelphia, Pa.; Railroads, S. T. Pearsons, 47 Terrill St., Rutland, Vt.; New York State, west and central, E. R. S. Reeder, Buffalo, N. Y.; Detroit territory, William A. Edwards, 2012 Dime Bank Bldg., Detroit, Mich.; Chicago territory, C. V. Luin, 928 Peoples Gas Bldg., Chicago, Ill.; Cincinnati territory, K. E. Porter, 816 Mercantile Bldg., Cincinnati, Ohio; Cleveland territory and Pittsburgh territory, V. S. Yarnall, 637 Guardian Bldg., Cleveland, Ohio.

THE PENARROYA MINING AND METALLURGICAL COMPANY of Paris has retained the American firm of Bradley, Bruff and LaBarthe to design a complete lead smelting and refining plant for erection at Penarroya, Spain. The plant will comprise crushing and sampling machinery, multiple hearth and Dwight and Lloyd roasting and sintering equipment, four large lead blast furnaces, one copper blast furnace, lead-copper matte converting plant, zinc desilverizing lead refinery and lead manufacturing machinery. The roasting and metallurgical furnaces will require pulverized coal.

THE UNITED STATES DEPARTMENT OF LABOR, working conditions service, has recently issued a memorandum showing the purposes and methods of industrial medical service in factories and large commercial organizations. Through the division of industrial hygiene and medicine, the working conditions service has laid out the program as follows:

To make studies of working conditions in their relation to health to determine hazardous processes and methods;

To formulate sanitary codes and regulations to meet health hazards in the various industries;

To formulate standards of medical practice in industries, to cooperate in the betterment of medical service in industries and industrial centers;

To determine standards of physiological requirements of various occupations;

To determine methods for proper placement of workers;

To secure statistical data of industrial morbidity;

To promote facilities for the education and training of physicians and sanitarians for industries;

To assist industries in obtaining physicians and other technicians for industrial service;

To disseminate information concerning measures necessary to safeguard workers against industrial health hazards, and to secure cooperation of all elements, governmental and private, in furtherance of the industrial health program.

The working conditions service particularly calls attention to its register of industrial physicians, which will aid manufacturers in getting in touch with physicians especially qualified for industrial service.

HAMILTON & HANSELL, INC., 13 Park Row, New York, has formally opened a steel warehouse at 141 Raymond Street, Brooklyn, which has been in existence since July, 1918, carrying a full line of tool steel and special alloy steels, in rounds, squares, octagons and sheets. Mr. C. U. Ackerlind is manager of the steel department.

THE SLIGO IRON & STEEL CO., Connellsville, Pa., makers of iron and steel bars, expects to make additions to its plants to increase output to 5000 tons monthly.

Manufacturers' Catalogs

THE INDUSTRIAL FILTRATION CORPORATION, 115 Broadway, New York City, has just received from the press a booklet describing andillustrating open tank filters, rotary filters, rotary clarifiers or thickeners, rotary hopper dewaterers and special filtration apparatus.

THE HYGEIA RESPIRATOR CO., 32 Monroe St., Passaic, N. J. A pamphlet describing the Diamond-Mask model "C" respirator.

E. H. SARGENT & CO., Chicago, Ill., calls attention in a pamphlet to Sargent's electric drying oven with automatic temperature control, giving directions for operating.

THE P. H. AND F. M. ROOTS CO., Connersville, Ind., calls attention to Catalog 68 on its rotary blowers. This is an attractive 48-page catalog which describes and illustrates many different types of blowers.

THE UNION THERMOMETER COMPANY, INC., 1301 Boston Road, New York City, has issued a special descriptive folder on chemical or laboratory thermometers, including the length of scale, range of scale and price per piece and per dozen.

THE GREEN ENGINEERING CO., East Chicago, Ind., has issued a 16-page booklet on Green materials transfer and storage hopper which is finding many uses in the chemical and allied fields for storing such materials as granular fullers earth, gilsonite, kieselguhr, ferrosilicon, bauxite, etc.

THE EDW. R. LADEW CO., INC., Glen Cover, N. Y., has issued an attractive catalog entitled "Ladew Leather Belting." It has 108 pages and illustrations and descriptive matter explaining step by step the operations involved to make the raw material into the finished product. A discussion is also given of belt engineering and belting economies.

MILLIKEN BROTHERS MFG. CO., INC. Woolworth Bldg., New York, call attention to an attractive 24-page booklet entitled "Space and Speed in Steel Buildings" descriptive of the standardizing truss unit system of building construction. Many interesting illustrations are given.

RAYMOND BROS. IMPACT PULVERIZER CO., Chicago, Ill.: Catalog No. 13 is a very attractive 64-page booklet on grinding, pulverizing and separating machinery. Illustrations and descriptive matter explain roller mills and pulverizers equipped with air separation for grinding all kinds of materials to powdered form. This catalog not only covers Raymond equipment but it gives some very good general ideas regarding pulverizing problems.

JOHN SIMMONS CO., 110 Centre Street, New York, calls attention to a 12-page booklet on the Leinert automatic gravity scales, for the automatic accurate weighing of liquids such as water, oil, sugar-juice spirits, petroleum, brine, acids, chemicals, etc. A description of the different uses for this scale, together with illustrations, is given.

THE RUTH COMPANY, Denver, Colo., describes and illustrates the Ruth flotation machine in a 12-page booklet. A copy can be had on request.

THE LINK-BELT COMPANY, Chicago, Ill., has just received from the press Book No. 353, "Economical Handling of Coal and Ashes and Reserve Coal Storage." By Henry J. Edsall. The booklet contains 52 pages of descriptive matter together with illustrations which are reprinted from a series of articles in *Steam* during 1917-1918. The same company also issues Book No. 333 "Link-Belt Equipment for the Handling and Preparation of Coal at the Mines." This attractive catalog contains 88 pages and illustrates coal tipples, conveyors, washeries and other equipment used at the mines.

THE CUTLER-HAMMER MFG. CO., Milwaukee, Wis., is distributing a novel two-page envelope folder which illustrates and enumerates the advantages of the C-H 91-16 starting switch for alternating current squirrel cage motors.

THE STAR BRASS WORKS, Chicago, Ill., has just received from the press Bulletin No. 4 pertaining to Spray cooling equipment as adapted for the re-cooling of condensing water for power and industrial plants.

THE FOXBORO CO., INC., Foxboro, Mass., calls attention to Bulletin 115, dated December, 1918, on power plant instruments which are used to reduce boiler-room expenses. This is an 8-page booklet, illustrated, which should be helpful to engineers who have not the time to look through the large bulletins issued by this company.

THE STEERE ENGINEERING CO., Detroit, Mich.: Bulletin No. 35 entitled "Tar Cameras for Colorimetric Tar Determination." This is an attractive 12-page booklet, well illustrated and supplemented by a colorimetric chart.

THE JOHN F. BYERS MACHINE CO., Ravenna, Ohio, has just received from the press Bulletin 1015 describing Model "3" autocrane. This 24-page catalog shows the various uses in many fields for the autocrane.

THE WALTER A. ZELNICKER SUPPLY CO., St. Louis, Mo., calls attention to Bulletin No. 250, which lists and illustrates rails, locomotives, cars, cranes, shovels, pipe, machinery, tanks, steel piling, power plant equipment, machine tools, wire rope, hoists and contractors' equipment. This bulletin is free to the trade.

THE GRISCOM-RUSSELL CO., 90 West St., New York: Bulletin No. 901 describes and illustrates the Multiwhirl Cooler, one of the uses of which is the removal of heat of waste liquors from chemical plants.

THE LAKEWOOD ENGINEERING CO., Cleveland, Ohio, sends as a New Year's greeting a very attractive booklet entitled "The Road to Peace," which is exceedingly interesting. It has 42 pages 10¾ in. by 14¼ in., printed in two colors and is profusely illustrated. Pictures are given of portable track, switches, and equipment being loaded onto a steamer for service overseas, military portable track piled in a French yard awaiting engineer requisition, and many others. One of especial interest is entitled "Blocking Off the Hun Advance Before the Second Battle of the Marne," which was snapped by a camera man with the American Expeditionary Forces and which shows a mine blowing up a bridge carrying Lakewood track.

New Publications

SOUTH DAKOTA SCHOOL OF MINES, Department of Geology and Chemistry, Rapid City, South Dakota, Bulletin No. 12 entitled "The Occurrence, Chemistry and Uses of Tungsten," with special reference to the Black Hills of South Dakota, by J. J. Runner and M. L. Hartman, including a bibliography of tungsten by M. L. Hartman, dated Sept., 1918.

THE FEDERAL BOARD FOR VOCATIONAL EDUCATION has issued a series of Opportunity Monographs. Vocational Rehabilitation Series, No. 5 "Army Occupations as Preparation for Civilian Employment"; No. 7 "The Metal Trades"; No. 8 "Factory Woodworking Trades"; No. 10 "Forestry Pursuits"; No. 11 "Automobile Maintenance and Service"; No. 12 "Employment Management" and No. 17 "The Practice of Medicine as a Vocation." These pamphlets are gotten out to aid the disabled soldiers, sailors and marines in choosing a vocation.

NEW BUREAU OF STANDARDS PUBLICATIONS: Tech. Paper No. 117 "Toluol Recovery" by R. S. McBride, C. E. Reinicker and W. A. Dunkley; Circular No. 2 "Design and Test of Standards of Mass." This third edition dated Dec. 23, 1918, supersedes the second edition entitled "Verification of Standards of Mass" issued Jan. 10, 1907.

NEW BUREAU OF MINES PUBLICATIONS: Bull. 154: Mining and Milling of Lead and Zinc Ores in the Missouri-Kansas-Oklahoma Zinc District. By Clarence A. Wright; Bull. 163: Methods of Shutting Off Water in Oil and Gas Wells. By F. B. Tough; Bull. 170: Extinguishing and Preventing Oil and Gas Fires. By C. P. Bowie; Tech. Paper 152: The Inflammability of Aluminium Dust. By Alan Leighton; Tech. Paper 171: Method of Least Squares Applied to Estimating Errors in Coal Analysis. By J. D. Davis and J. G. Fairchild; Tech. Paper 198: Sulphur Dioxide Method for Determining Copper Minerals in Partly Oxidized Ores. By Charles E. Van Barneveld and Edmund S. Leaver; Tech. Paper 200; Colloids and Flotation. By F. G. Moses; War Minerals Investigations Series No. 3 dated Dec., 1918, entitled "Preparation of Crucible Graphite" by Geo. D. Dub; Bull 161: Law Serial 13 California Mining Statutes Annotated. By J. W. Thompson, including all California mining laws.

NEW UNITED STATES GEOLOGICAL SURVEY PUBLICATIONS: II:36, Stone in 1916. By G. F. Loughlin. (Mineral Resources of the U. S., 1916, Part II, pages 993-1087), published Nov. 25, 1918; II:18, Asphalt, Related Bitumens and Bituminous Rock in 1917. By John D. Northrup. (Mineral Resources of the U. S., 1917, Part II, pages 232-251), published Oct. 22, 1918; II:22. Fluorspar and Cryolite in 1917. By Ernest F. Burchard. (Mineral Resources of the U. S., 1917, Part II, pages 293,304), published Nov. 20, 1918: I:9. Gold, Silver, Copper and Lead in Alaska in 1917. Mines Report. By G. C. Martin. (Mineral Resources of the U. S., 1917, Part I, pages 131-145), published Nov. 21, 1918.